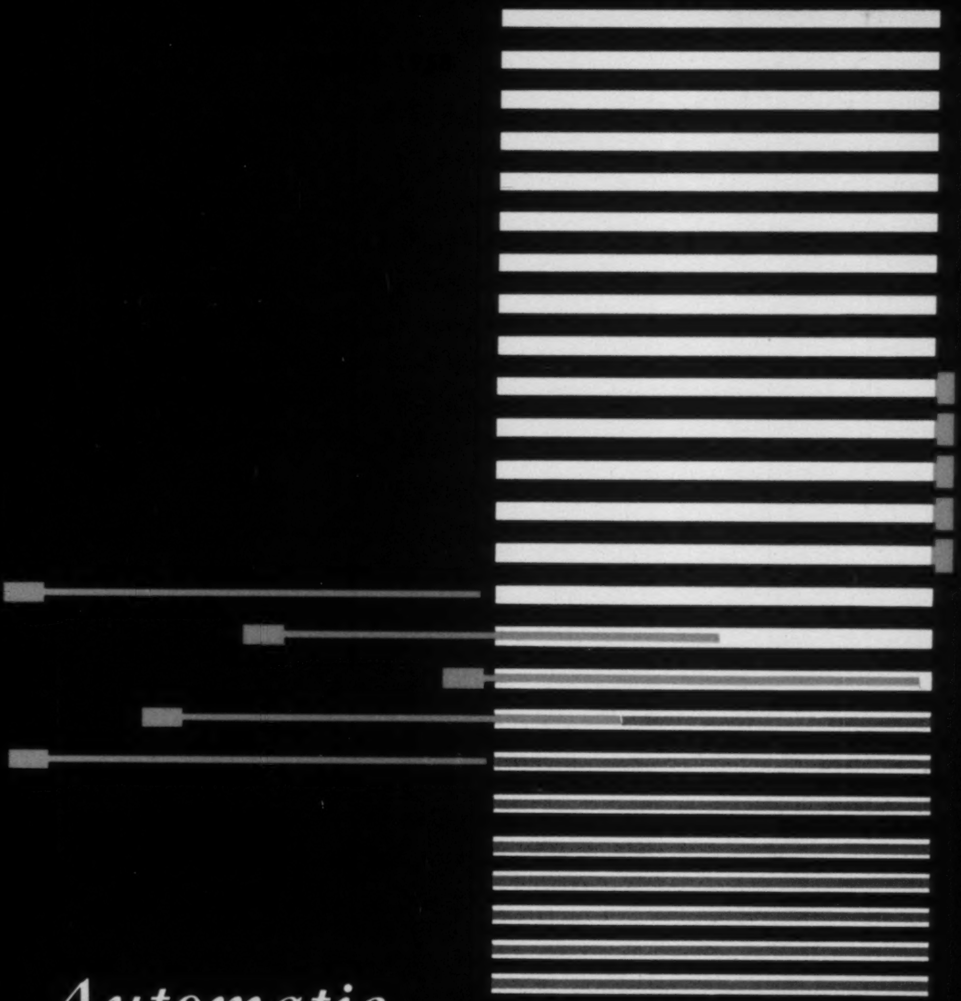
AUTOMATION



Automatic Spray Painting

OF ELECTRICAL CONDUIT

The Magazine of Automatic Operations

A PENTON PUBLICATION

At Westinghouse, production men agree on economy of Wean coil processing

Until recently, the Electric Appliance Division plant of Westinghouse Electric at Columbus, Ohio was supplying its production lines with steel purchased in sheet form and individually resquared. Some 75 sheet sizes had to be stocked to meet varying requirements.

The installation of Wean slitting and shearing lines in August, 1957 was made after a careful cost analysis of this production process. Now, after five months operating experience, here is how production management at this Westinghouse plant summarizes the advantages of the Wean coil processing system:

Materials Savings: in addition to the initial savings realized by the purchase of coil rather than sheet, scrap is reduced by the close control and accuracy possible on Wean slitting and shearing equipment. Coil is slit in a variety of widths, from 3 to 48 inches, to supply both the shearing line and press lines, now being coil-fed.

Inventory Savings: 3 or 4 standard coil sizes now provide the production flexibility for which 75 sizes of mill-prepared sheet were previously required. In addition prime plant space for sheet production and storage has been reduced and inventory turnover increased.

Low-Cost Versatility: differing assembly line requirements for sheet are now met quickly and easily, without production delay or the expense of special purchases.

The mechanized handling of metal possible with the Wean slitting and shearing lines also has reduced direct labor costs, freeing men for work in other production departments. And the production rate of the Wean system is more than adequate to match the plant's usage of coil and sheet: in one three-day period, 350 tons of coil were processed on the shearing line.

If you use sheet steel in quantity, it's likely that these same savings could result from your plant's use of Wean slitting and shearing equipment. One of our experienced sales engineers will be glad to explore with you the economics of processing from coil to fill your production requirements. May we hear from you?

Mr. M. W. Stretch, right, of the Manufacturing Planning Department, and his assistant, Mr. M. Avery, discuss Wean's slitting line "after hours."

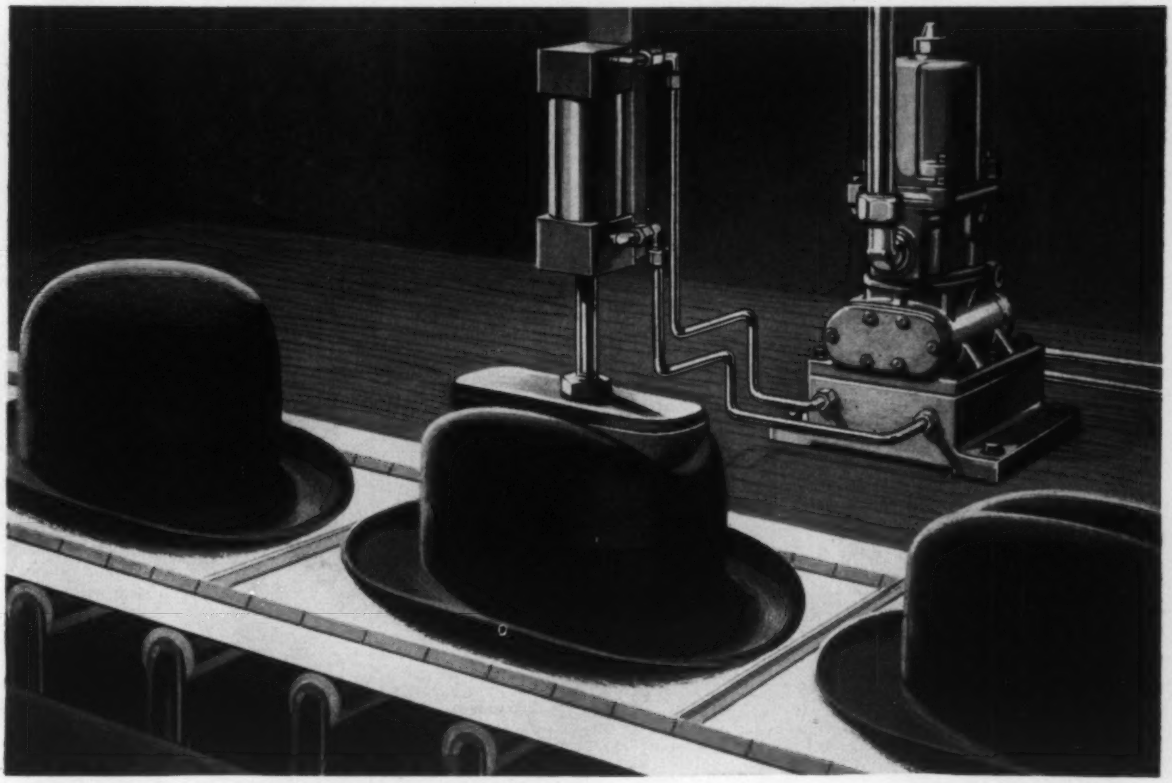
WEAN

WEAN EQUIPMENT CORPORATION
CLEVELAND 17, OHIO
Detroit • Chicago • Newark

Circle 651 on Page 17

What? A Homburg Dimpler!

Unlikely?...Yes, but...



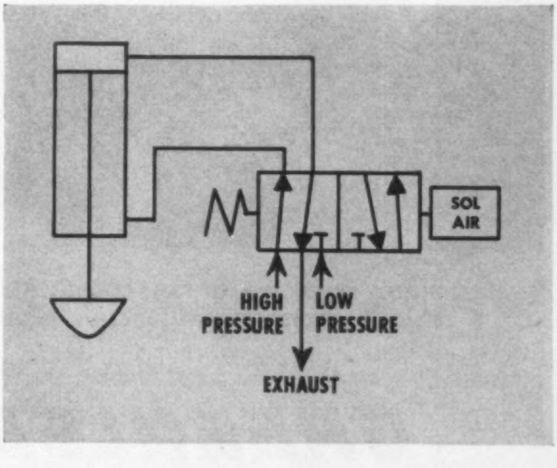
Unlikely? Yes—most men will continue to give the top of their pet fedora a "just-right" push of the fist when they buy it back from the hat check girl. But this little flight into fancy does give us a chance to show a cylinder with a split personality . . . able to advance softly, then retreat quickly to get the next hat into position without waste of time. It's made possible with a Ross 4-way, 5-port valve that provides a *different* pressure for each side of the cylinder.

Maybe you have a serious problem that the Ross 4-way, 5-port valve can solve

The same idea of cylinder advance and retreat is put to very real and valuable use in many machines today. Perhaps you, too, have an application where *one* valve controlling *two* pressures will cut production costs. Contact your nearby Ross Service Engineer or write us for details on the 4-way, 5-port valve.

Combining engineering with ingenuity
for better air control

ROSS OPERATING VALVE CO.
131 East Golden Gate • Detroit 3, Michigan

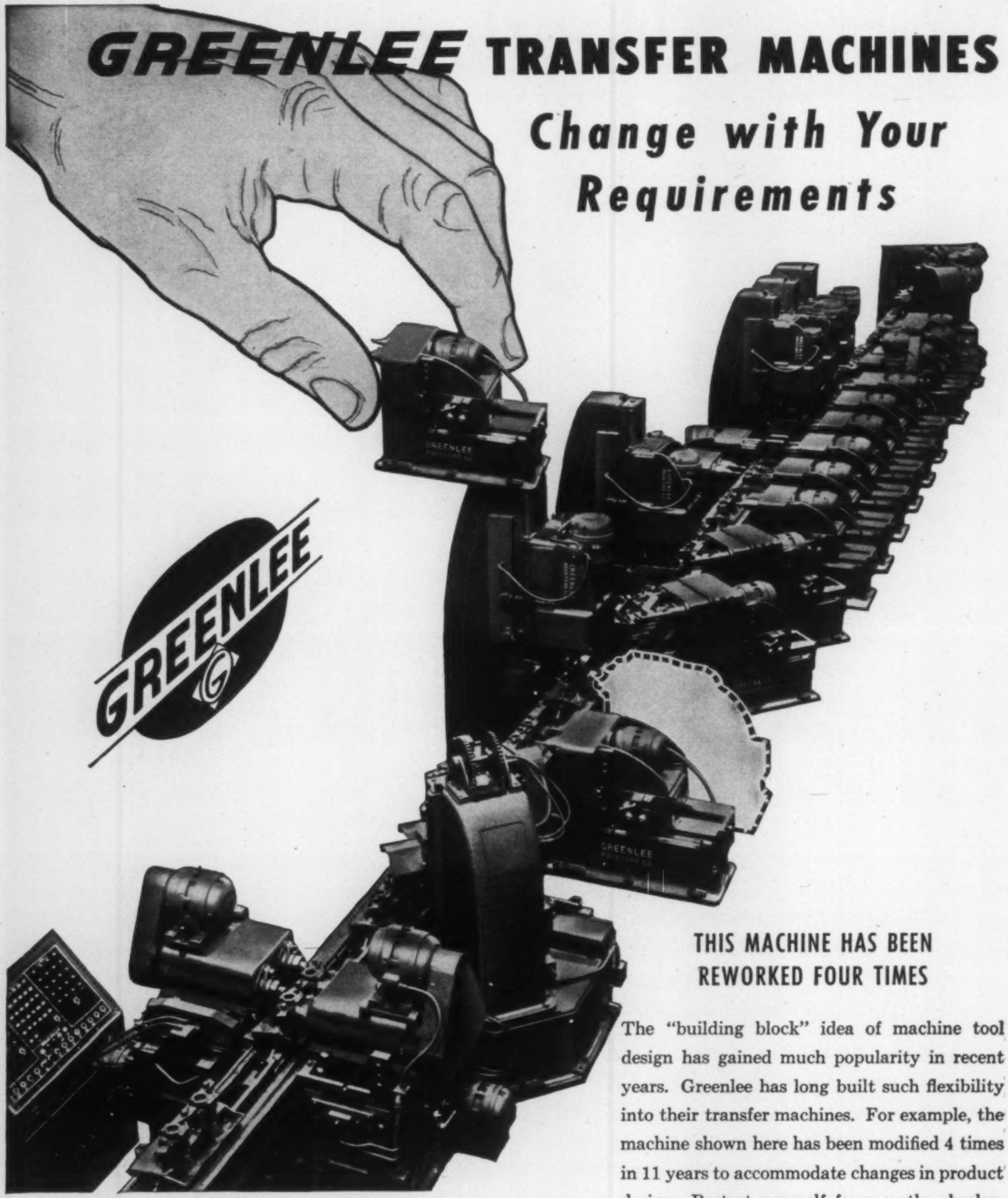


1. Solenoid is energized, creaser descends slowly.
2. Solenoid is de-energized, creaser rises quickly.

Circle 654 on Page 17

GREENLEE TRANSFER MACHINES

Change with Your Requirements



GREENLEE

THIS MACHINE HAS BEEN REWORKED FOUR TIMES

The "building block" idea of machine tool design has gained much popularity in recent years. Greenlee has long built such flexibility into their transfer machines. For example, the machine shown here has been modified 4 times in 11 years to accommodate changes in product design. Protect yourself from costly obsolescence. Ask Greenlee to show you how.

PHONE ROCKFORD, ILLINOIS 3-4881
TO HELP SOLVE YOUR PRODUCTION PROBLEMS

GREENLEE
BROS. & CO.

2083 MASON AVE.
ROCKFORD, ILLINOIS

Circle 655 on Page 17

MARCH 1958
Vol. 5 — No. 3

AUTOMATION®

The Magazine of Automatic Operations

A PENTON PUBLICATION

ROGER W. BOLZ, Editor

EDITORIAL STAFF
JAMES C. KEEBLER, Managing Editor
JOHN H. McRAINEY, Associate Editor
LEE D. MILLER, Associate Editor
WILLIAM E. STALHUTH, Associate Editor
JULIAN E. WILBURN, Associate Editor
JEANNE M. RIBINSKAS, Assistant Editor
HELEN M. VERESPY, Editorial Assistant

EDWARD D. KARL, Art Editor

EDITORIAL OFFICES
Penton Building, Cleveland 13, Ohio

The Right Perspective, 53
EDITORIAL—benefits of automation can be achieved in small-lot operations by exercise of imagination and ingenuity.

Automation for Small-Lot Producers, 54
SPECIAL REPORT—records concepts and techniques for improved production as developed by an Automation Task Force.

Systems Approach, 54
ARTHUR F. MAYNARD—obtaining maximum benefits from automation program requires study of entire operation.

Manufacturing Functions, 58
EDWIN SUURONEN—considerations for the economic justification of automatic equipment in short-run manufacturing.

Quality Control, 61
LESTER E. MCCABE—examination of type of labor content in inspection and functional testing is guide to mechanization.

Information Processing, 65
RUSSELL P. MILIOTO—systems approach leads to development of data handling routines which satisfy specific requirements.

Automatic Spray Painting, 69
ERIC H. COCKS—study of considerations and equipment pertaining to coating of conduit interior surfaces.

Combination Gaging Systems, 73
R. ALLEN SOULER—concluding part of series on dimensional controlling systems for automatic production machines.

Static Controls Automate Molding, 75
HYDRAULIC PRESS—equipped with static control devices produces plastic pump impellers for automotive application.

Controlling One Double-Acting Cylinder, 78
H. L. STEWART and J. M. MORITZ—part two of series devoted to theme of basic pneumatics for automation.

Versatile Machine Control, 82
E. W. SMITH—gear hobbing application illustrates use of unique control package programmed by replaceable elements.

Hydraulic Actuation Simplified, 86
W. C. WEBER—reaction of plug in bore to hydraulic actuation is convenient source of linear force for machines.

Selective Feeding Control, 89
STEPPING SWITCHES—widely used in telephone applications are valuable components in industrial control circuits.

Automation in Action, 92
PICTORIAL PRESENTATION—case loader, pipe production, multispindle unit, press brake, and drill fixture.

Automatic Weighing and Blending, 94
W. E. MILLIGAN—characteristics of pneumatic weigh cell permit its use in variety of bulk material weighing applications.

REGULAR DEPARTMENTS

Automation Outlook, 4
Automation News, 9
Readers' Reply Card, 17
Meetings and Events, 33
Detroit Dateline, 43
Problem Forum, 51
New Equipment, 99
New Components, 117
New Literature, 140
Abstracts, 146
Books, 156
Patents, 158
Editorial Index, 160
Advertising Index, 163

automation outlook

SMALL BUSINESS RESEARCH

". . . the dollar that is put into research in a small business is a more valuable dollar than that available to the giants of industry. It must, therefore, be more closely directed in use. And it is. Its administrative burden is smaller. Its freedom in use is less. It must be spent in pursuit of practical research. The men who use it are usually nearer to the problems to which the research is directed, more dependent upon its productive employment, more affected by its successful exploitation, than is frequently the case of the dollar lost in the huge budgets of large research laboratories . . . Very frequently the 'breakthrough', the startling innovation, comes from small business and small laboratories. . ."—*C. W. Ooms, patent counsel, LaSalle Steel Co.*

SMALL-LOT AUTOMATION

". . . several things may be done to reshape or mold a business to make it compatible with automation. If there are common denominators among products, components, materials, processes, or methods, these common denominators can be combined to establish volume. The most obvious tactic is to gather all these likes together in one place. The second and not so obvious method is to create common denominators by control of design through engineering standards. . ."—*Arthur F. Maynard, chairman, automation task force, General Electric Co., see page 54.*

". . . automation of short-run production is not only desirable but feasible both technically and economically. However, the approach must be a new one, fundamentally different from that used in high-production industries today. Since high volume is usually requisite to economic justification, it must be created in one form or another and, simultaneously, machine requirements must be simplified through controlled product design. Although production output cannot very well be tripled if the market for the product isn't that great, something can be done in the area of product design to modulize or standardize parts so that the volume of certain characteristics of the product is increased. . ."—*Edwin Suuronen, automation task force, General Electric Co., see page 58.*

". . . the rapid development of instrumentation leads us to believe that instrumentation will not be the most significant limitation to our progress. The real challenge is the establishment of realistic design standardization which will foster the economic justification of automatic test equipment for our lowest production quantities. . ."—*Lester E. McCabe, automation task force, General Electric Co., see page 61.*

". . . in the case of information handling generally, volume does exist abundantly, normal conditions favor automation, economic justification looks favorable, the paperwork is relatively free from obsolescence and likely to increase in volume, and the technology and many machines are available. The only thing lacking is the systems planning for specific jobs. Our systems approach has already been stated as the formulation of the needs of each part of the system from an understanding of the whole system. . ."—*Russell P. Milioto, automation task force, General Electric Co., see page 65.*

AUTOMATION

Penton Building, Cleveland 13, Ohio
Main 1-8260

R. C. JAENKE
Business Manager

BUSINESS STAFF

LARRY D. BRENNAN, Advertising Sales Mgr.
ELIZABETH ROOT, Advertising Service Mgr.
J. M. CASTIGLIONE, Production Mgr.
S. F. MARINO, Promotion Dir.
J. C. GERNHARD, Circulation Dir.
D. C. KIEFER, Marketing Director
JUNE SCHILENS, Reprints

Advertising Representatives

New York 17 ....60 East 42nd St.
EDWARD S. LAWSON, ROBERT S. MADDOX
Murray Hill 2-2581

Cleveland 13 ....Penton Building
JOHN D. SAUNDERS
Main 1-8260

Chicago 11 ....520 North Michigan Ave.
RICHARD W. JONES, RAYMUND A. GROSS
Whitehall 4-1234

Detroit 35 ....15800 West McNichols Rd.
DONALD C. HYDE, BRADLEY MacKIMM
Broadway 3-8150

Los Angeles 5 ....730 South Western Ave.
The Robert W. Walker Co.
ROBERT W. WALKER, CHARLES F. MEISTER
Dunkirk 7-4388

San Francisco 4 ....57 Post St.
The Robert W. Walker Co.
ROGERS PARRATT, JOSEPH KELLER
Sutter 1-5568

Griffin, Ga. ....1106 Pine Valley Rd.
FRED J. ALLEN
Griffin 7854

Dallas 23 ....923 Cordova Ave.
EDWARD J. WHETZLE
Davis 4-4016

London, S.W. 1 .....2 Caxton St., Westminster

Published by

THE PENTON PUBLISHING COMPANY

G. O. HAYS ....President
R. C. JAENKE ......Executive Vice President
F. G. STEINEBACH ....Vice Pres. and Secretary
F. O. RICE ....Vice President
J. P. LIPKA ....Treasurer and Asst. Secy.

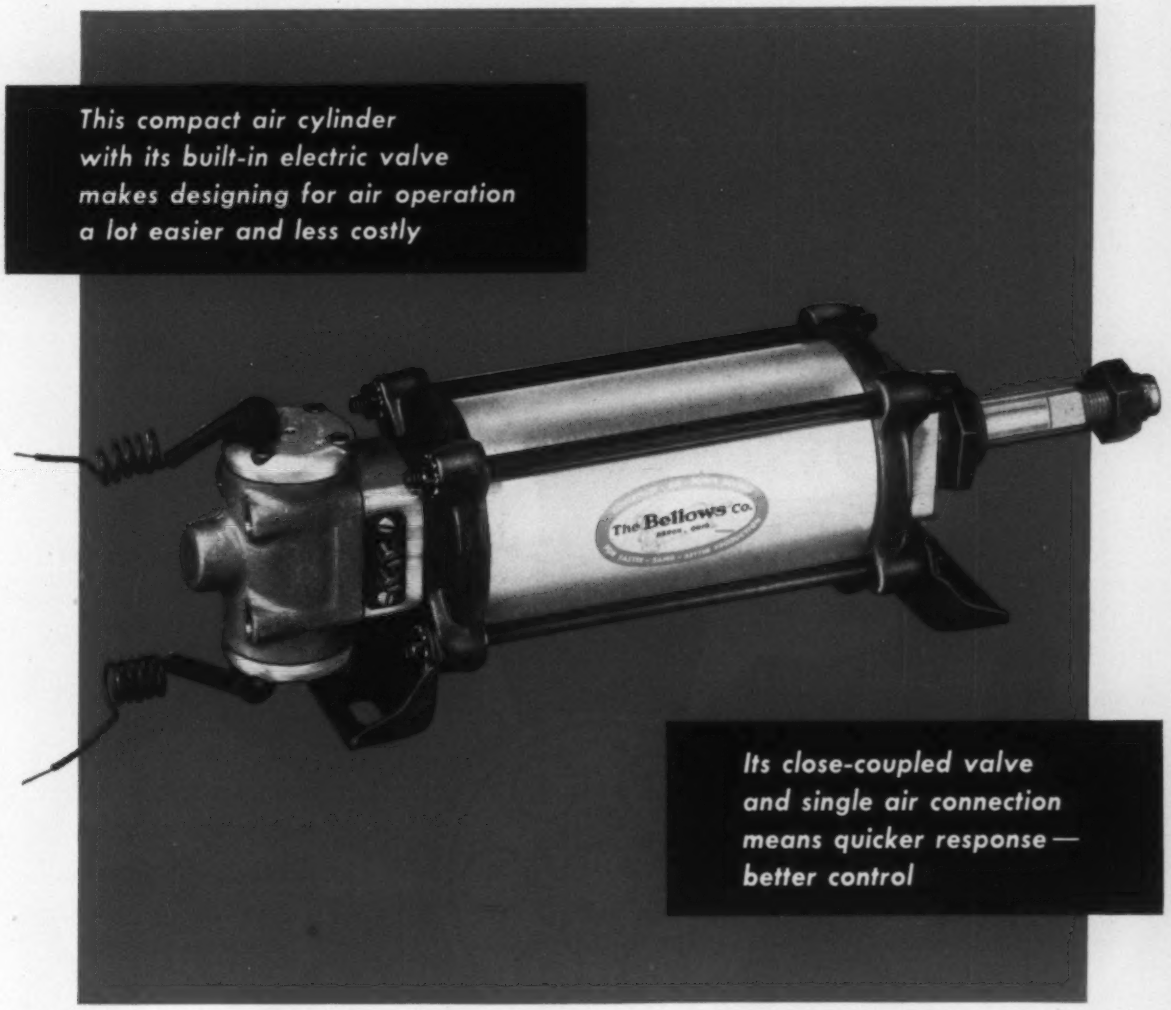
Also Publisher of
STEEL • FOUNDRY • MACHINE DESIGN
NEW EQUIPMENT DIGEST

AUTOMATION is selectively distributed without charge to plant and business management responsible for initiating use of automation; to production, plant and systems engineers who plan and specify automated operations; and to engineers, designers and control specialists who design automatic machines, systems and plants. Copies are distributed, to U. S. and Canadian companies only, on the basis of one for each group of four or five readers. Consulting and industrial engineering firms, research institutions and U. S. Government installations with similar responsibilities are also eligible.

Subscriptions in United States, possessions and Canada for home-addressed copies and those not qualified under above rules: One year $10. Single copies $1.00. Other countries: One year $20.

Published monthly and copyrighted 1958 by Penton Publishing Co., Penton Bldg., Cleveland 13, Ohio. Accepted as Controlled Circulation Publication at Cleveland, Ohio.

When requesting changes of address, etc., please allow four to six weeks for processing.



This compact air cylinder with its built-in electric valve makes designing for air operation a lot easier and less costly

Its close-coupled valve and single air connection means quicker response — better control

ONE QUICK LOOK TELLS YOU WHY THE BELLOWS AIR MOTOR OFFERS MORE VALUE TO USERS OF AIR CYLINDERS

As you can see, it takes but little more space, built-in valving and all, than a conventional air cylinder alone, without valve. Its single air connection (which can be inexpensive and easily installed flexible hose) makes it simple to install on moving machine elements. Its low voltage (8-12 v.) electrically controlled valve* permits less costly wiring, simpler hook-up, and easy interlock with related movements.

1013-B-1

Bellows Air Motors are fully described in Bulletin BM-25. It contains helpful data every methods man can use. We'll be happy to send you a copy without cost or obligation. Write Dept. AU-358, The Bellows Co., Akron 9, Ohio. In Canada, Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario.

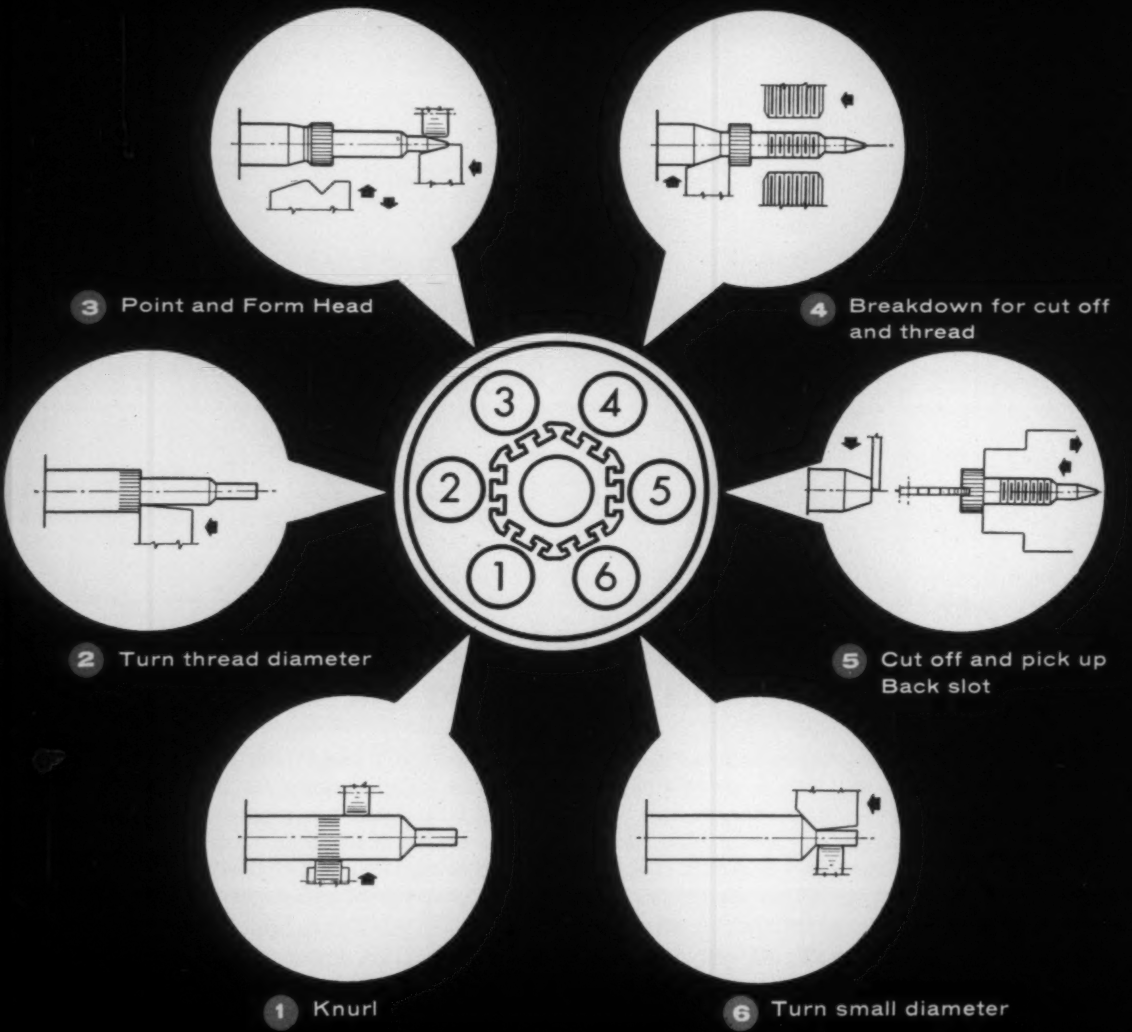
What you can't see in the picture is equally important. The Bellows Air Motor is built to rugged standards — to provide millions of cycles of trouble-free service. Yet if trouble should arise, there is a Bellows Field Engineer within easy phone call eager to help you.

Bellows Air Motors are built in five bore sizes: 1¼", 1¾", 2½", 3⅝" and 4½"; in any stroke length; and in six integral valve styles.

If your designs call for air operation, you'll be time and money ahead with the Bellows Air Motor.

The Bellows Co.
DIVISION INTERNATIONAL BASIC ECONOMY CORPORATION
AKRON 9, OHIO

here's circumferential automation at work.....


3 Point and Form Head
4 Breakdown for cut off and thread
2 Turn thread diameter
5 Cut off and pick up Back slot
1 Knurl
6 Turn small diameter
3
4
2
5
1
6

In this example of circumferential automation, 9 operations are performed in 3 seconds to complete this carbureter idle adjustment screw. This part and thousands of others, many more complex, are produced to close tolerances, at high speeds and low costs on Acme-Gridley automatics.

circumferential automation*

pioneered by National Acme, saves floor space, reduces machine tool investment, lowers machining costs.

*Each spindle on an Acme-Gridley Automatic is an efficient work station where pre-sequenced operations are performed in succession without manual attention. This is automation . . . circumferential automation.

Circumferential Automation, inherent in all Acme-Gridleys since 1893, goes other forms of automation one step better. Instead of a line of machines, transfer devices and other space-consuming equipment, Acme-Gridley Multiple Spindle Automatics provide for maximum automatic production in a *single machine*. This means you save floor space, machine investment and man-hours.

Acme-Gridley Automatics with their "wide open" tooling zone provide maximum machining flexibility. Their extra heavy, extra sturdy "box" construction assures day-in, day-out production with minimum human attention.

Let us show you how Circumferential Automation can go to work for you—speed your production, improve production quality *and* lower your unit cost. Our representative will be glad to call without obligation.

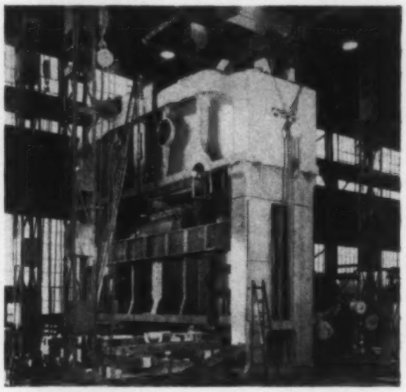
National Acme

THE NATIONAL ACME COMPANY, 196 E. 131ST ST., CLEVELAND 8, OHIO • Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

All 'round the world where there's work to be done
and time to be saved there's an Acme-Gridley to do it.

Circle 657 on Page 17

(Advertisement)



TWO 100-TON "A" FRAMES. (CCC built) were needed to position the crown of this big Hamilton press.

THERE'S A BETTER WAY . . .

"Task Force Tactics" Save Money on Tough Machinery Installations

YES, there's a way to make and save money when having machinery installed. First, be sure the job is handled by a professional installer. Then make certain that your professional working partner is fast, accurate and responsible.

When stubborn problems develop on a big industrial installation, only a miracle can get the project back on schedule. Commercial Contracting Corporation, a leading U. S. installer based at Detroit, has an effective solution. A task force of specialists is assigned to cover each phase of an installation. Each unit is a self-sufficient team capable of completing the job without additional help. A twin-engine airplane whisks key operating personnel from job to job. Mobile telephones link home office and project activities.

A Commercial Contracting Corporation spokesman says "The task force approach is the only positive method we have of tying together the hundreds of details in the installation of complicated machinery. Delays boost the price of the equipment. By maintaining or beating schedules, we make money for our customers."

This technique was born of necessity to keep pace with postwar industrial expansion. Yesterday's makeshift methods could not meet the challenge. Task force tactics do, and industrial installations have become a big and specialized business.

CCC's reputation, gained through the installation of seven of the 10 major automotive press plants built since 1947, now reaches into the steel, aluminum and other basic metals industries. The company, trained in serving the auto industry, applies its task force techniques to major installations of automation machinery, rolling mills, foundries, press plants and other types of manufacturing equipment.

That's why leading users agree that installing industrial machinery and equipment is not a do-it-yourself project. There's a better, faster and more economical way.

CCC's 16-page illustrated brochure, "Industrial Installations," explains these services more fully. To obtain a copy or help on your own problems, address your request to Commercial Contracting Corporation, 12160 Cloverdale, Dept. 1-A, Detroit 4, Michigan.

A TYPICAL CCC "TASK FORCE" UNIT headed by J. C. McLure, *Project Coordinator.* On his left E. C. Sawyer, *Estimating Engineer,* U. A. Strang, *Director-Purchasing* and C. M. Wasson, *Company Pilot.* On Mr. McLure's right C. J. Duke, *Superintendent-Operations.* Q. C. Clark, *General Superintendent* and his *Assistant Superintendents* L. A. Watson and F. Cangemi.

AUTOMATION news

Today's events and developments in the field of automation

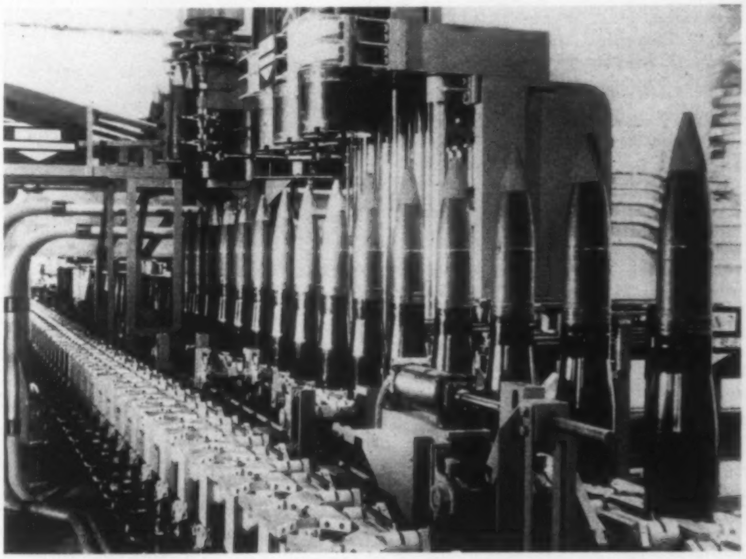
AMF Contracts To Build Automated Shell Filling Line

CONTRACT for building a fully automated shell filling line has been awarded to the American Machine & Foundry Co. by the U. S. Army Ordnance Dept. The new system, designed by AMF's Mechanics Research Dept., will handle either 75 or 90 mm shells and will be installed at the Joliet, Ill., Arsenal.

The fully automated line will be divided into twelve stations which will be monitored by a single operator sitting at a control console. Five television monitors in front of the operator will be tied into cameras focused on critical operations in the process.

Shell cases and primers will be decartoned, assembled to each other, and inspected at the beginning of the line. After transfer to the main conveyor, the shells will be positioned in groups of three under weigh hoppers from which accurately weighed batches of smokeless powder pellets will drop into the casings. At succeeding stations along the line, projectiles will be stenciled and crimped into the shell cases. Completed shells will be gaged in simulated gun tube chambers and off-weight or outsized shells will be automatically sidetracked from the line. Final stations in the line will handle the packaging of the finished shells. Each shell will be fed into a cylindrical container having a shock-absorbing filler at each end to protect the primer. After sealing the cylinder, the packages will be stenciled and crated for shipment.

The complex principle of weighing the propellant and filling the shell accurately in a rapid automatic process has been proved on equipment built and installed at the Arsenal. Completion of the balance of the installation is scheduled for the near future.



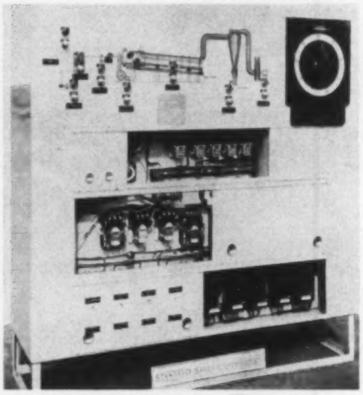
AUTOMATED shell filling line, designed and built by American Machine & Foundry Co., handles either 75 or 90 mm shells. Single operator at a control console watches key stations along the assembly line on five television monitors. In addition, complete instrumentation provides the operator with full information on critical operations in the process.

GE Motor Plant Emphasizes Production Flexibility

HIGHLY - MECHANIZED factory has been built by General Electric Co. at Schenectady, N. Y., for the production of 40 to 125 horsepower electric motors. The $7.5 million facility is a part of the Small A-C Motor and Generator Dept. which opened another $7 million factory less than two years ago for the production of 7½ to 30 horsepower motors.

Flexibility of production is one of the highlights of the new factory. Since less than one-third of the motors in the 40-125 horsepower class are of standard design, GE designed the plant on the basis of producing special design motors as economically as possible. This was accomplished by designing standardized motor parts which could be produced in volume and assembled in various combinations to meet a wide variety of motor requirements. Important economies were also effected by investing heavily in automatic materials handling equipment.

The new manufacturing facility consists of two buildings. One building houses equipment which performs various automatic machining operations on motor components. A conveyor carries the components



CONTROL PANEL for an automatic rotary dryer was designed and built by Standard Steel Corp. The automatic unit will be used in Cuba for drying silica sand and features a schematic diagram of the installation on the control panel which shows the location of driving motors and burner, and the flow of material, air, and fuel. All dryer operations are controlled from the panel which was designed for ease of operation in a non-English-speaking country.

into the second building to various "drop-off" points where motor frames, shafts, end-shields, and other parts are picked off for assembly. Separation of machining and assembly operations in two buildings insures against cast iron dust settling into motor assemblies.

On the basis of volume, separate production lines could not be justified in the second or assembly building. Therefore, one production line was designed to handle both standard and special motors. All parts travel in the same flow path during machining and assembly. Special motors have their own process areas located next to standard process areas to which they are scheduled when their manufacture would interfere with the normal flow of standard motors. This setup allows maximum flexibility in producing various mixes of standard and special motors.

Integrated data processing equipment is used by the engineering department to originate parts lists and production orders on receipt of a customer's order for special motors. This information is then transmitted over the IDP system to the various production and assembly points in the factory. Scheduling, shipping, and billing operations are also handled by the IDP system.

A future issue of AUTOMATION will cover the General Electric production line in detail.

Federal Agency Translates Foreign Technical Publications

ESTABLISHMENT of a Foreign Technical Information Center within the Department of Commerce has been announced by the Secretary of Commerce **Sinclair Weeks**. The new program will be headed by **John C. Green** and will collect, evaluate, and distribute valuable foreign scientific and technical literature for use by American scientists and engineers.

"In recent years, government agencies, private institutions and industries have steadily increased their translation of Soviet magazines, monographs, and books," said Secretary Weeks. "At the present time, however, there is no central agency in the Government responsible for acting as a clearinghouse on all such foreign, technological, scientific, and engineering information for the purpose of making it generally available to American scientists, research institutions, and the public."

Arrangements have been made to obtain copies of abstracts and translations of foreign technical articles, monographs, and books from organizations such as the National Science Foundation, Atomic Energy Commission, the armed services, and the intelligence agencies. It is estimated that these will be supplied at an annual rate of 50,000 abstracts and 10,000 complete translations. The items will be cataloged in the library of the Office of Technical Services. It is planned that the abstracts will be published and released to the technical press, and that copies of translations will be made available to the public.

The co-operation of industry, universities, libraries and commercial translation firms will be sought in feeding information to the center. A staff of engineer-translators will be added to review and analyze foreign publications and select those of the greatest value for translation. Among the materials available for review are copies of 200 Russian scientific journals.

Warehouse Stock Controlled By Electronic Computer

COMPUTER controlled warehouse system has been installed in the San Francisco warehouse of Factory Motor Parts Inc., wholesale distributor of Chrysler Corp.'s automotive products. Key to the new system is a 305 RAMAC computer and accounting machine which was developed and manufactured by International Business Machines Corp.

Factory Motor Parts will use the machine to do its inventory control and customer billing. The company serves more than 2500 customers in its area and stocks over 23,000 items in a 40,000 sq ft warehouse.

When an order is received in the company's phone room, it is proc-

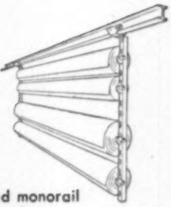
STAFF of AUTOMATION regretfully records the death of *Frank G. Woollard*, British Correspondent, who has authored the monthly column "Notes from Britain" for the past year.

This magazine opened its pages to Mr. Woollard's writings on the subject of automation in recognition of his pioneering efforts in the field. Prior to contributing to this magazine, Mr. Woollard had enjoyed a distinguished career in British industry and was the author of "Principles of Mass and Flow Production," a British textbook dealing with automation in the metalworking industry. During the last several years, he was an advisor to a number of companies on the subject of automation and allied fields.

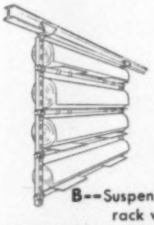
Mr. Woollard's pertinent and interesting reports on automation developments in Britain and Europe will be genuinely missed by the staff and readers of AUTOMATION.

12 WAYS TO HANDLE ROLLS

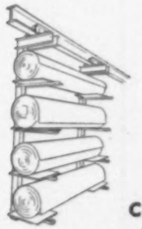
SELECT THE COST-SAVING METHOD WHICH MEETS YOUR NEED



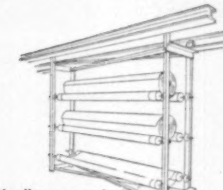
A—Suspended monorail rack with vertically adjustable spindles and supports.



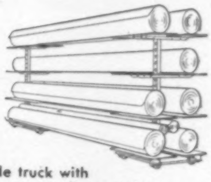
B--Suspended monorail rack with vertically adjustable spindles and pallet supports.



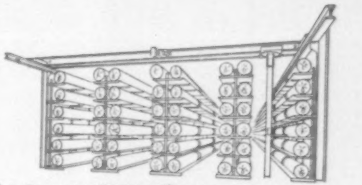
C—Suspended monorail rack with vertically adjustable pallet supports.



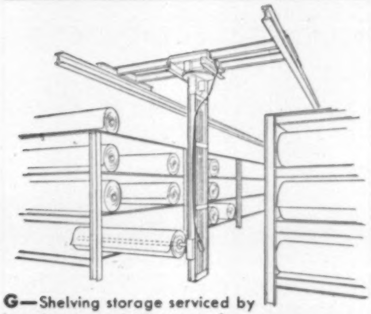
D—Vertically suspended monorail rack with rotating canvas belts for live storage.



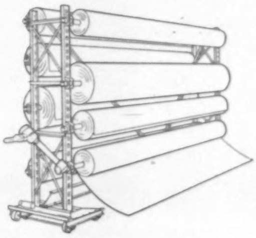
I—Mobile truck with vertically adjustable or fixed pallet supports. Manual or power driven.



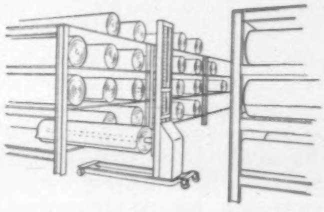
L—Free-standing cantilever pallet racks serviced by revolving fork lift suspended from overhead crane.



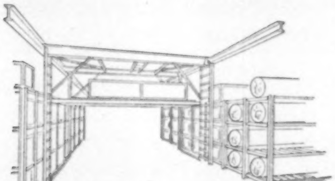
G—Shelving storage serviced by inserting a ram in the core of the roll. Ram suspended from overhead crane.



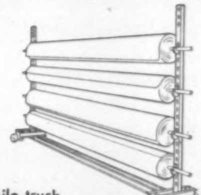
K—Mobile truck with double suspension and vertically adjustable spindle supports. Manual or power driven.



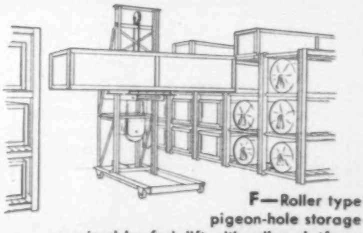
H—Shelving storage serviced by a ram-type truck.



E—Roller type pigeon-hole storage with elevating platform supported from overhead crane.



J—Mobile truck with single suspension and vertically adjustable spindle supports.



F—Roller type pigeon-hole storage serviced by fork lift with roller platform.

Consult the Specialists! We have broad experience in solving roll handling and storage problems, and have developed a number of simplified methods which have many patented features for handling practically any type of rolled material.

Phone, Wire or Write—a preliminary survey by our experienced technical men costs nothing—may save big money.

FLOOR COVERING EQUIPMENT COMPANY DIVISION
CHICAGO TRAMRAIL CORPORATION 1306 So. Kostner Ave. • Chicago 23, Illinois

essed into the computer. The electronic unit immediately determines if the part is in stock, if it has been superseded by an improved model, its location in the warehouse, and other information needed to print out the shipping order and the warehouse "picking ticket." In the same operation, the machine automatically prices the item and makes all the computations necessary for the preparation of the invoice including discounts and sales taxes. It also runs a routine credit check on the customer and updates all pertinent sales and accounts receivable records with details of the transaction.

In addition to handling customer accounting operations, the computer system analyzes the sales trends on each item and arrives at an ideal stock level for each part. If an order depletes the stock below this level, a notification card is punched by the machine. At the end of the week, these cards are used to obtain the latest inventory status of the item for preparation of an order review list.

With the continuous survey of sales trends and stock levels, Factory Motor Parts will be able to reduce its inventory to a minimum. At the same time, the advanced warning system will mean fewer lost sales from lack of stock on hand.

European Labor Team Visits American Industry

TEAM of top European labor leaders recently toured the United States and discussed the social and economic aspects of technological improvement with representatives of management and labor at various industrial plants. In the course of the tour, the group visited the staff of AUTOMATION for a round-table discussion of the part automation progress plays in industrial employment. The team was composed of representatives from England, France, Germany, Denmark, Holland, and Italy and was sponsored by the European Productivity Agency of the Organization for European Economic Co-operation.

Automation Influence Dominates Packaging Machinery Show

COMPLETE redesign of packaging machinery that was made necessary by automation influences will be dominant throughout the 1958 Packaging Machinery & Materials Exposition to be held at Convention Hall, Atlantic City, on March 25 through 28.

The exposition is sponsored by

Air Cushion Control Technique Aids Plastic Forming

NEW technique in vacuum forming called air cushion control has been developed by Auto-Vac Co. for use in molding heavy gage polyethylene, Kralastic, high-impact styrene, and other commonly used thermoplastics. Key to the process is a method by which cushions of air on both sides of the hot plastic prevent the deep-drawn material from contacting the chilling faces of the mold until the plastic has stretched to the general shape of the molded piece.

The new process results in high uniformity of wall thickness and relatively low corner radii in the molded piece. Another advantage of the new method is that the forming is done against a cool cavity mold. This results in rapid chilling of the formed plastic, faster forming cycles, and less problem in the removal of formed parts.

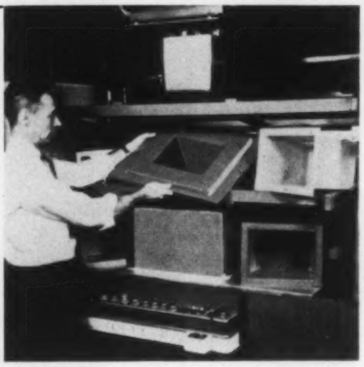


Fig. 4—Samples of various types of containers molded with new process. Film development tank shown in illustration is 12 inches deep with 2 degree wall taper from top to bottom. Corner radii are held to 1/4 inch and lip radius at top is 1/2 inch.

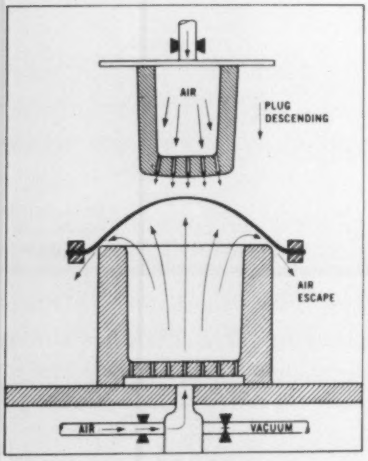


Fig. 1—Plastic is held in clamping frame and heated to molding temperature. Air is introduced into cavity mold and rapid pressure build-up causes soft plastic to balloon into bubble above mold. Excess air escapes over the lip of the mold.

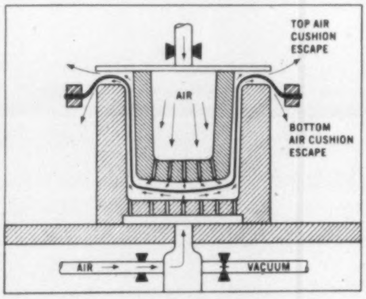


Fig. 2—As the hot plug descends into the mold, air escaping from bleed holes in the plug forms an air cushion. Air below plastic in cavity continues to escape over lip. Two air cushions hold plastic away from chilling surfaces of mold.

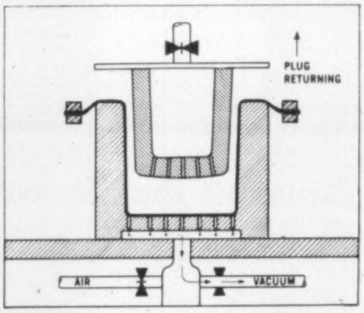
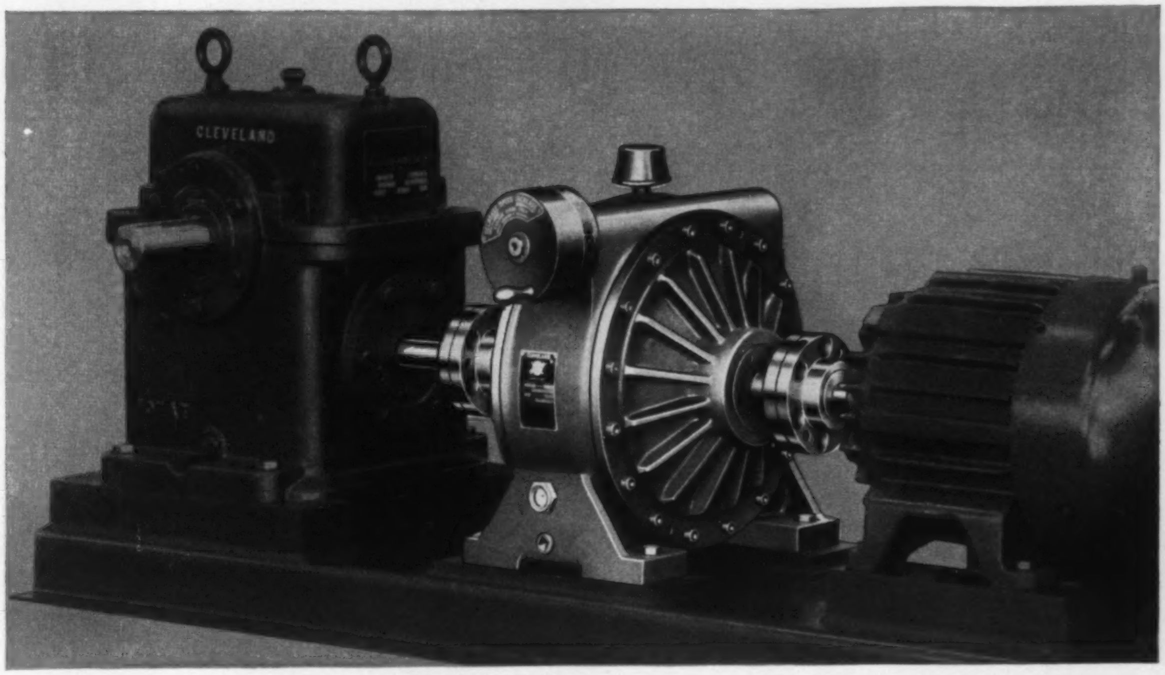


Fig. 3—At full descent of plug, hot plastic has stretched to general shape of mold. Air introduction is stopped and vacuum is drawn to snap plastic tightly against mold. Plastic chills rapidly in cold mold and may be removed quickly.

Industry's most positive mechanical-type variable speed drive



CLEVELAND SPEED VARIATOR

Supplemented with speed reducers can provide reduction ratios to 10,000:1

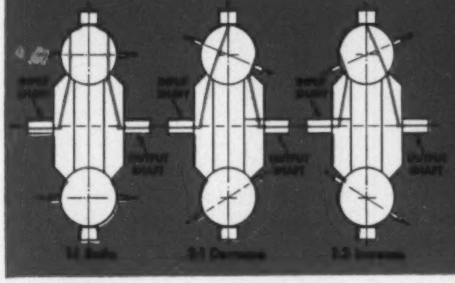
IN installing a Cleveland Speed Variator, the higher the input speed (normally 1750 rpm), the smaller the unit needed. Where power must be delivered at speeds below the Variator's normal output shaft speeds, further reductions are available between Variator and driven equipment.

As illustrated above, the Variator may be assembled with a standard worm gear speed reducer or with integral double reduction helical gear trains. Write for Bulletin K-200. The Cleveland Worm & Gear Company, Speed Variator Division, 3265 East 80th Street, Cleveland 4, Ohio.

Note these major advantages of the Cleveland Speed Variator

1. An extremely compact unit, with input and output shafts in line and rotating in the same direction.
2. Operable at any input speed up to 1800 rpm—either clockwise or counterclockwise rotation.
3. Rated for constant horsepower output over a 9:1 or 6:1 range; or for constant torque over a 6:1 range.
4. Infinitely variable output speeds over the entire range of adjustment.
5. No slippage—positive, automatic torque adjustment in direct proportion to the loads encountered.

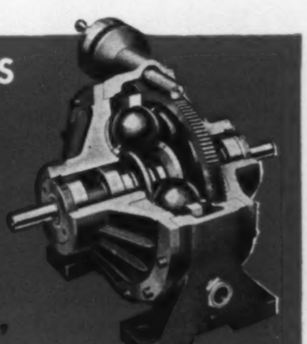
HOW THE CLEVELAND SPEED VARIATOR WORKS



Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts.

Relative speeds of the shafts are adjusted by changing the positioning of axles on which the balls rotate (diagram, right, shows cutaway Variator with hand regulating wheel).

"It's the Drive That's on the Ball."



Circle 660 on Page 17

the Packaging Machinery Manufacturers Institute. **W. B. Bronander Jr.**, president of PMMI, said, "The packaging industry is currently experiencing a strong trend toward automated processes." Bronander explained that some of the new machinery being used throughout the industry makes it possible to secure complete automation from raw material to finished product through the use of automatic weighing, packaging, sealing, labeling, and cartonizing units. Unit costs are subsequently reduced and production is expedited.

More than 150 manufacturers will exhibit this year in the large convention hall. The majority of displays will be "action exhibits" showing the equipment performing actual packaging operations. Augmenting the show will be a series of technical sessions sponsored and conducted by Packaging Institute, New York.

ANNUAL meeting of the Business Forms Institute was recently held in New York and **William C. Lamprechter**, vice president and general manager of Stephen Greene Co., was installed as the new president. He succeeds **R. S. Daugherty**, president of Shelly Salesbook Co. **T. S. Duncanson**, president of Moore Business Forms Inc., was elected first vice president of the organization and **Thomas A. Taylor**, vice president of Schwabacher-Frey Co., continues to fill the post of second vice president.

Airmerge System Blends Dry Materials In Bulk

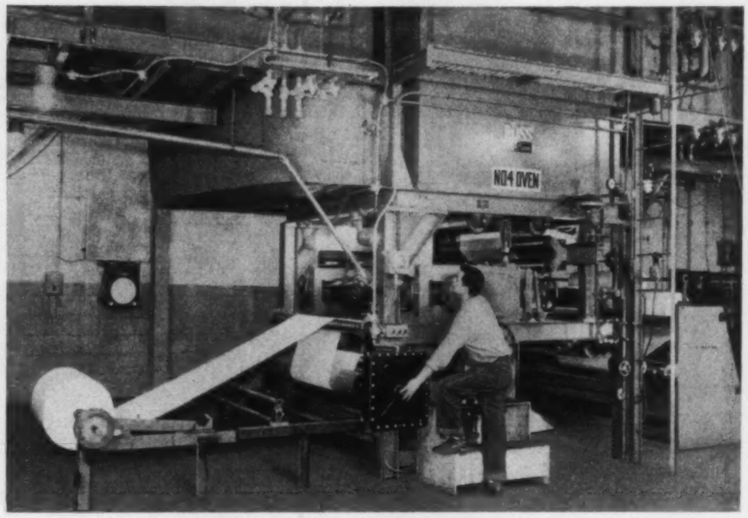
BLENDING of dry bulk pulverized materials such as cement, fly ash, and other chemical substances by using an airmerge system has been developed by Fuller Co., a subsidiary of General American Transportation Corp. The new method can be used on any materials which can be fluidized by compressed air.

The airmerge blending method makes use of a round silo with a flat bottom. Aeration units cover the bottom of the silo in quadrants and are closely placed to give uniform distribution of air. Porous refractory blocks are used to face off the aeration units so as to release the air in innumerable fine jets.

In operation, compressed air is applied in pulsations to one quarter of the silo bottom at a time in a volume sufficient to fluidize the dry material above the quadrant. As a result of being expanded and at the same time becoming fluid, material rises above the level of the adjacent three quadrants and flows out across them at a rapid rate. A small amount of compressed air is released through the inactive quadrants to make the material above them mushy, but without any basic change from its unaerated density.

Heavier material in the inactive quadrants tends to slump over into the active quadrant where it becomes aerated and flows upward. Therefore, a strong and continuous roll-over motion in a vertical circuit is obtained which results in an intensive and thorough mixing.

Aeration is periodically switched from quadrant to quadrant in rotation. After two complete circuits of all quadrants, the material is usually completely blended. The Fuller airmerge system is suited for either batch or continuous operation, depending upon how many silos are used. It is capable of blending materials with different bulk densities and finenesses and works at a high tonnage capacity resulting in reduced manhours of labor per ton.



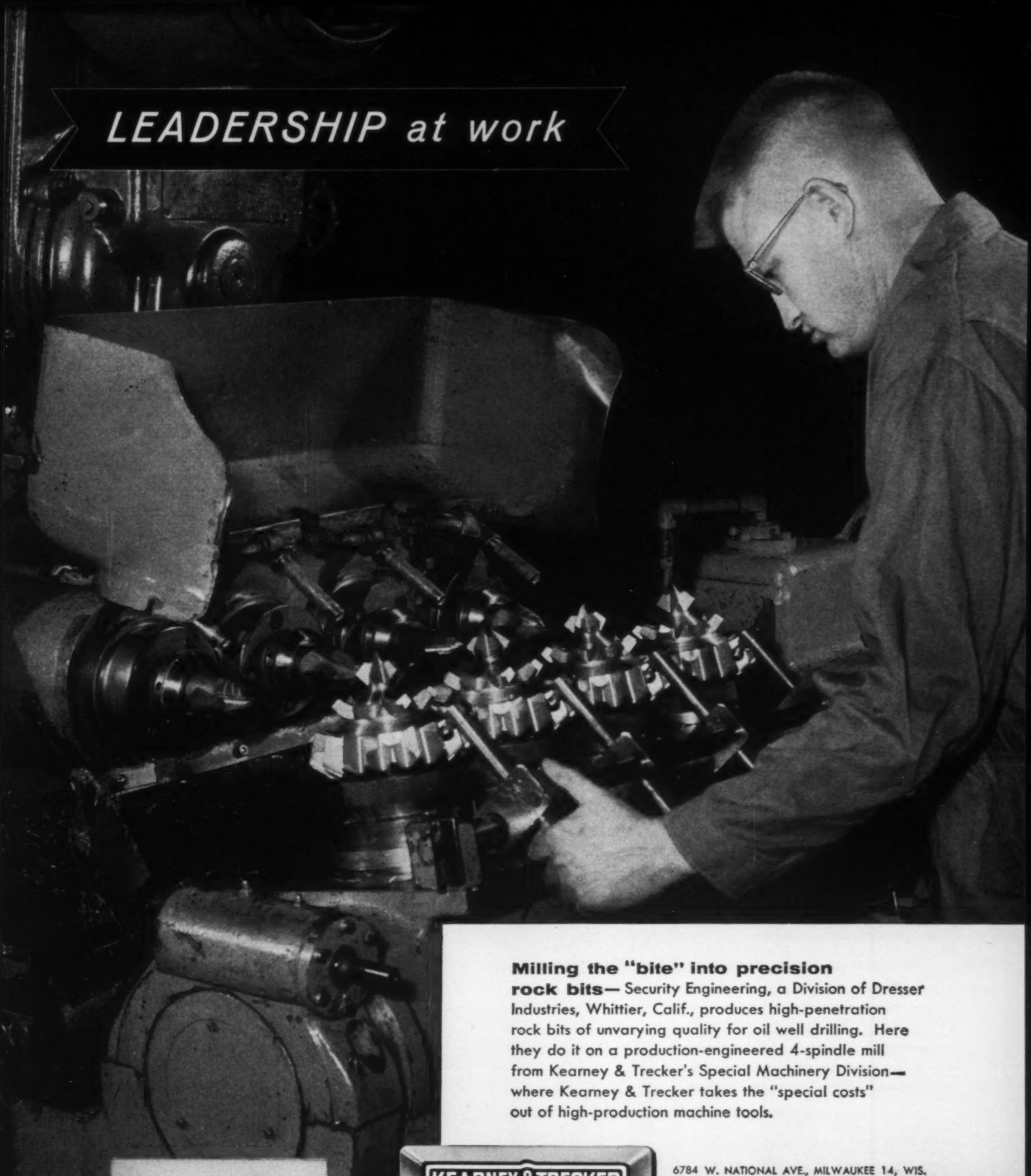
VERTICAL impregnating oven has been installed at Fabricon Products Inc. to coat various materials with plastic solutions. The 35-foot high oven incorporates such features as electronic speed and web tension controls, squeeze rolls which permit precise control of resin content, and accurate oven temperature control. Typical of the materials being processed in the new oven is a light glass cloth destined for use as molded turbine blades for jet engines. The unit was designed and built jointly by John Waldron Corp. and J. O. Ross Engineering Corp.

Solion Transducer Being Commercially Developed

COMMERCIAL development of the solion, an electronic device that may replace the transistor at frequencies below 100 cycles per second, is being jointly carried on by National Carbon Co., a division of Union Carbide Corp., and Texas Research Associates. Based on both electrochemical and fluid flow principles, the solion is extremely sensitive, and its low power requirements make it ideal for remote and unattended devices.

Unlike electron tubes and transistors, which rely on electron flow to transport electrical charges, the solion utilizes ions in solution. When an alternating pressure is applied to the device, iodine ions in solution are forced into contact with platinum electrodes, and the ensuing electrochemical reaction releases electrons and causes a correspondingly large increase in the flow of electrical current in an external circuit.

In many applications, the solion

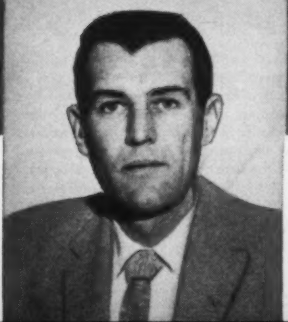


Milling the "bite" into precision rock bits— Security Engineering, a Division of Dresser Industries, Whittier, Calif., produces high-penetration rock bits of unvarying quality for oil well drilling. Here they do it on a production-engineered 4-spindle mill from Kearney & Trecker's Special Machinery Division— where Kearney & Trecker takes the "special costs" out of high-production machine tools.

KEARNEY & TRECKER
MILWAUKEE

6784 W. NATIONAL AVE., MILWAUKEE 14, WIS.

Kearney & Trecker staff photo by Ron Johnson

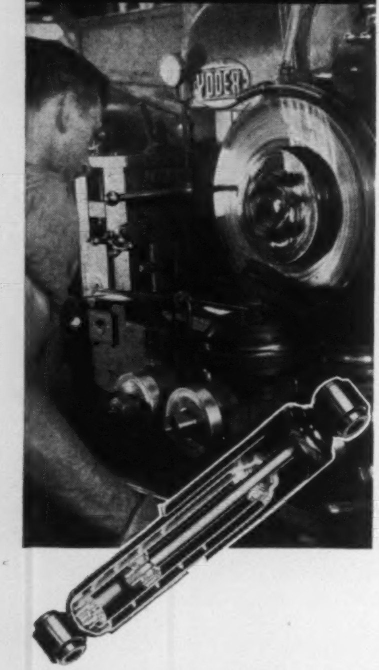


Kearney & Trecker's man on the job . . .

Verne Kidwell of Moore Machinery Co., Los Angeles, followed through from original planning to final installation of the 4-spindle rock bit mill. *For expert milling counsel, call the Kearney & Trecker man near you. And remember to ask him, or write direct for free comprehensive catalog.*

Circle 661 on Page 17

Monroe Shock Absorbers
rely on
Precision Performance of
YODER TUBE MILLS



After 15 years of continuous operation the Yoder Type-M Electric-Resistance Weld Tube Mill shown here, is still producing precision tubing for the Monroe Auto Equipment Co., Monroe, Michigan. Yoder produced tubing is the basic component of the famous "Monro-Matic" shock absorber. Measuring 2 1/64" outside diameter (plus several other sizes) the tubing is made from 22 gauge strip in one continuous operation . . . it is automatically cold-roll formed, welded and cut to pre-determined lengths.

This typical installation of a Yoder tube mill exemplifies the accuracy, dependability and production economies of Yoder-made tubing. If your business requires pipe or tubing, ferrous or non-ferrous, in sizes from 1/4" to 26" diameters, there is a Yoder mill designed to produce it economically, efficiently and accurately.

THE YODER COMPANY
5526 Walworth Ave. • Cleveland 2, Ohio

Check into the many cost-saving advantages of operating a Yoder pipe or tube mill . . . write for the fully-illustrated 88-page Yoder Tube Mill Book . . . it is yours for the asking.

ENGINEERING YODER MANUFACTURING

PIPE AND TUBE MILLS
(ferrous or non-ferrous)

Circle 662 on Page 17

will replace a complicated circuit of resistors, capacitors, inductances, and electron tubes or transistors. Their small size and light weight make solions well suited to portable devices. It is expected that solions will eventually find wide use in process control systems, analog computers, data processing equipment, and similar applications.

Control System Increases Output Of Glass Bottles

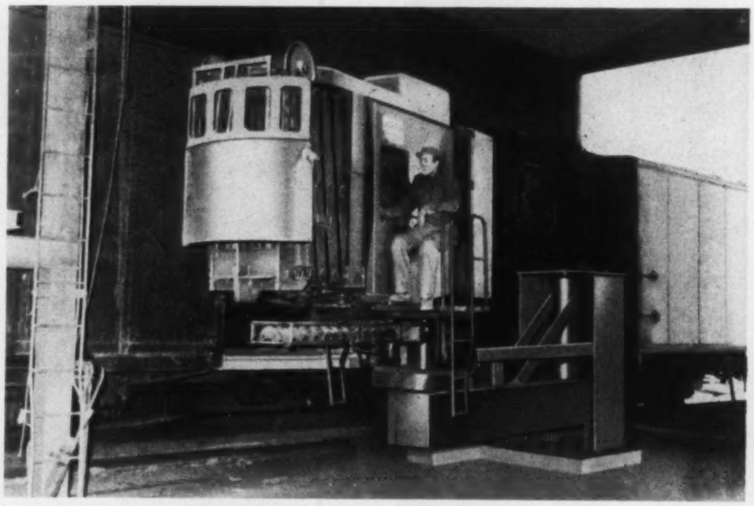
AUTOMATIC control of cooling air has made possible the production of more and better glass containers at lower cost according to **Paul M. Spatz**, plant engineer of Diamond Glass Co. The control system maintains the temperature of molten glass being fed to bottle-forming machines at set levels and makes temperature conditioning of flint glass containers fully automatic.

Proper control of cooling air long has been a problem in the glass container industry. Glass is refined and melted to a temperature several hundred degrees higher than required at the forming machines. During the flow of glass through the forehearth—a tunnel-like structure between the refining end of the melting furnace and the spout where gobs are extruded for forming—excess heat is applied. Cooling air is usually necessary to reduce temperatures.

Manual control of cooling air usually results in non-uniform temperatures rendering off-grade glass and excessive use of fuel. Automatic control has been installed to eliminate these conditions. Principal component of the new system is a pneumatic indicator-controller produced by the Brown Instrument Div., Minneapolis-Honeywell Regulator Co. On receiving a signal from a temperature controller, the unit sends its own signal to air motors. These motors actuate dampers and valves, regulating the cooling air so that a minimum amount of heat is applied to the molten glass as it flows through the forehearth.

Data Processing Courses Offered By Consulting Firm

ESTABLISHMENT of the Management Science Training Institute, a division of John Diebold & Associates Inc. has been anounced by **John Diebold**, president. One of the first projects scheduled for the organization is a series of one-week



HYDRAULICALLY-OPERATED box car unloader developed by Stephens-Adamson Mfg. Co. can unload granular, pulverized, or other free-flowing materials from a box car in less than 30 minutes. Boom swivel and scoop actions are hydraulically actuated and can be operated automatically during much of the unloading cycle. When set in motion, the scoop is in a raised position. The boom extends until the scoop meets resistance in the form of material or the car wall which causes the scoop to dig into the material. The boom retracts and pulls the loaded scoop to the open car door for discharge. After discharging, the scoop rises automatically and the boom extends to repeat the cycle.

EXTRA COPIES OF ARTICLES • ADVERTISED PRODUCTS OR SERVICES • CATALOGS & LITERATURE starts on page 139 • NEW COMPONENTS starts on page 117 • NEW EQUIPMENT starts on page 99

AUTOMATION
READER SERVICE

Use an Inquiry Card

FOR FURTHER INFORMATION ON ANYTHING DESCRIBED OR ADVERTISED IN THIS ISSUE

Circle item number for further information on anything described or advertised in this issue

401	431	461	491	521	551	581	611	641	671	701	731	761	791
402	432	462	492	522	552	582	612	642	672	702	732	762	792
403	433	463	493	523	553	583	613	643	673	703	733	763	793
404	434	464	494	524	554	584	614	644	674	704	734	764	794
405	435	465	495	525	555	585	615	645	675	705	735	765	795
406	436	466	496	526	556	586	616	646	676	706	736	766	796
407	437	467	497	527	557	587	617	647	677	707	737	767	797
408	438	468	498	528	558	588	618	648	678	708	738	768	798
409	439	469	499	529	559	589	619	649	679	709	739	769	799
410	440	470	500	530	560	590	620	650	680	710	740	770	800

411	441	471	501	531	561	591	621	651	681	711	741	771	801
412	442	472	502	532	562	592	622	652	682	712	742	772	802
413	443	473	503	533	563	593	623	653	683	713	743	773	803
414	444	474	504	534	564	594	624	654	684	714	744	774	804
415	445	475	505	535	565	595	625	655	685	715	745	775	805
416	446	476	506	536	566	596	626	656	686	716	746	776	806
417	447	477	507	537	567	597	627	657	687	717	747	777	807
418	448	478	508	538	568	598	628	658	688	718	748	778	808
419	449	479	509	539	569	599	629	659	689	719	749	779	809
420	450	480	510	540	570	600	630	660	690	720	750	780	810

421	451	481	511	541	571	601	631	661	691	721	751	781	811
422	452	482	512	542	572	602	632	662	692	722	752	782	812
423	453	483	513	543	573	603	633	663	693	723	753	783	813
424	454	484	514	544	574	604	634	664	694	724	754	784	814
425	455	485	515	545	575	605	635	665	695	725	755	785	815
426	456	486	516	546	576	606	636	666	696	726	756	786	816
427	457	487	517	547	577	607	637	667	697	727	757	787	817
428	458	488	518	548	578	608	638	668	698	728	758	788	818
429	459	489	519	549	579	609	639	669	699	729	759	789	819
430	460	490	520	550	580	610	640	670	700	730	760	790	820

AUTOMATION **March, 1958**

SEND COPIES OF FOLLOWING ARTICLES IN THIS ISSUE

Page No.	Title of Article
....	....
....	....
....	....

Must Be Filled Out Completely—Type or Print

NAME

TITLE

COMPANY

PRODUCT MANUFACTURED

ADDRESS

CITY ZONE

STATE

Do not use this card after May 15, 1958

Circle item number for further information on anything described or advertised in this issue

401	431	461	491	521	551	581	611	641	671	701	731	761	791
402	432	462	492	522	552	582	612	642	672	702	732	762	792
403	433	463	493	523	553	583	613	643	673	703	733	763	793
404	434	464	494	524	554	584	614	644	674	704	734	764	794
405	435	465	495	525	555	585	615	645	675	705	735	765	795
406	436	466	496	526	556	586	616	646	676	706	736	766	796
407	437	467	497	527	557	587	617	647	677	707	737	767	797
408	438	468	498	528	558	588	618	648	678	708	738	768	798
409	439	469	499	529	559	589	619	649	679	709	739	769	799
410	440	470	500	530	560	590	620	650	680	710	740	770	800

411	441	471	501	531	561	591	621	651	681	711	741	771	801
412	442	472	502	532	562	592	622	652	682	712	742	772	802
413	443	473	503	533	563	593	623	653	683	713	743	773	803
414	444	474	504	534	564	594	624	654	684	714	744	774	804
415	445	475	505	535	565	595	625	655	685	715	745	775	805
416	446	476	506	536	566	596	626	656	686	716	746	776	806
417	447	477	507	537	567	597	627	657	687	717	747	777	807
418	448	478	508	538	568	598	628	658	688	718	748	778	808
419	449	479	509	539	569	599	629	659	689	719	749	779	809
420	450	480	510	540	570	600	630	660	690	720	750	780	810

421	451	481	511	541	571	601	631	661	691	721	751	781	811
422	452	482	512	542	572	602	632	662	692	722	752	782	812
423	453	483	513	543	573	603	633	663	693	723	753	783	813
424	454	484	514	544	574	604	634	664	694	724	754	784	814
425	455	485	515	545	575	605	635	665	695	725	755	785	815
426	456	486	516	546	576	606	636	666	696	726	756	786	816
427	457	487	517	547	577	607	637	667	697	727	757	787	817
428	458	488	518	548	578	608	638	668	698	728	758	788	818
429	459	489	519	549	579	609	639	669	699	729	759	789	819
430	460	490	520	550	580	610	640	670	700	730	760	790	820

AUTOMATION **March, 1958**

SEND COPIES OF FOLLOWING ARTICLES IN THIS ISSUE

Page No.	Title of Article
....	....
....	....
....	....

Must Be Filled Out Completely—Type or Print

NAME

TITLE

COMPANY

PRODUCT MANUFACTURED

ADDRESS

CITY ZONE

STATE

Do not use this card after May 15, 1958

Information Service

For your convenience, advertisements and items of information on new equipment, components and manufacturers' literature can be quickly identified by an *Item Number* accompanying each unit.

For additional free information circle item number on an inquiry card. Fill in your name, title, address, etc.—Drop it in the mail—No Postage Required—Your request will receive prompt attention and will be filled directly by the manufacturer.

So that you won't have to clip this issue, we will gladly send you a personal copy of any article. Just fill in the page number and title of the article you desire.

FIRST CLASS
Permit No. 36
CLEVELAND, OHIO

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

—4c POSTAGE WILL BE PAID BY—

AUTOMATION
Penton Building
Cleveland 13, Ohio

Reader's Service Dept.

FIRST CLASS
Permit No. 36
CLEVELAND, OHIO

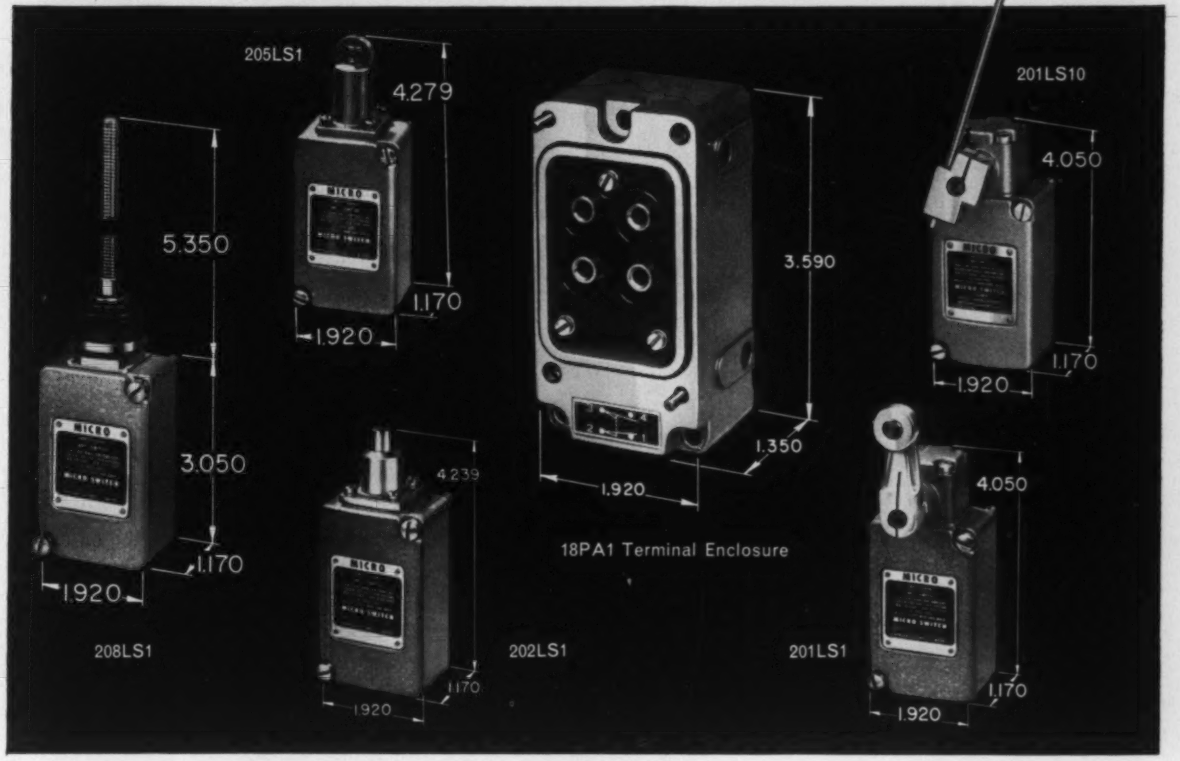
BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

—4c POSTAGE WILL BE PAID BY—

AUTOMATION
Penton Building
Cleveland 13, Ohio

Reader's Service Dept.

MICRO SWITCH Precision Switches



This NEW MICRO SWITCH "Plug-in Limit" Switch cuts downtime to 20 seconds

The new MICRO SWITCH "Plug-in Limit" Switch plugs in like a radio tube and can be replaced in seconds.

It offers all the features of rugged construction and precision long-life operation, so necessary in a limit switch. The assembly of the terminal block and switching unit comprise a complete switch thoroughly sealed against cutting oils, chips, dirt and dust. The "200LS" series switches meet NEMA standards.

The switch enclosure, including all moving mechanical and electrical parts, is plugged into the terminal block, precisely positioned by means of dowel pins. Under normal conditions the terminal enclosure need never be removed from the machine.

18PA1 Terminal Enclosure—This enclosure is common to all actuator assemblies in the "200LS" series. Can be mounted from front, back or either side. All switch enclosures illustrated above fit this terminal enclosure. Two No. 10 captive screws secure the two enclosures together.

208LS1 Coil Spring Actuator—flexible spring actuator for multi-direction operating motion.

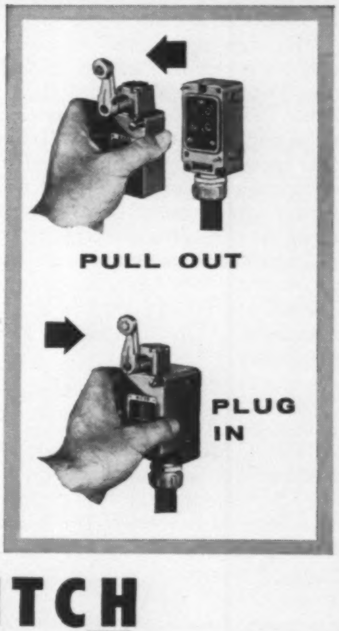
205LS1 Roller Plunger Actuator—adjustable at 90° angles.

202LS1 Push Plunger Actuator—for in-line actuating motion.

201LS10 Rod Actuator—provides light actuating force. See adjustability details under 201LS1 below.

201LS1 Roller Arm Actuator—field adjustable for actuation in either clockwise or counter-clockwise, or in both directions. Arm is adjustable through 360° Actuating head can be faced in any of four directions.

For details of the "200LS" series, send for Bulletin No. 20.



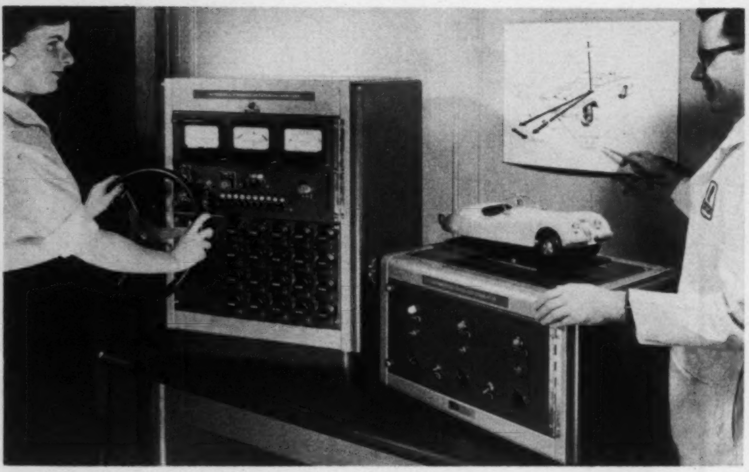
The two-word name "MICRO SWITCH" is NOT a generic term. It is the name of a division of Minneapolis-Honeywell Regulator Company.

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS

First in Precision Switching

Circle 663 on Page 17



ELECTRONIC analog computer linked with a miniature automobile on a simulator enables research engineers of General Motors Corp. to determine how a full-size vehicle would respond to various steering gear "inputs" on the highway. An automobile moving down a highway is subject to certain lateral motions such as yawing, rolling, or sideslipping. The effect of these motions is dependent on the car's speed, wheelbase, steering gear ratio, weight distribution, tire properties, and suspension geometry. Equations of lateral response relating to these variables have been developed, and the electronic computer continuously solves these equations as the steering wheel is manipulated. Changes in the variable characteristics can be made by adjusting the controls of the computer. This gives the engineers an immediate visual idea of how a full-size automobile would respond to actual manipulation of the steering wheel.

management level courses on the effective uses of automatic data processing in business and will be offered in 17 North American and 10 European cities.

The American series of courses will be entitled "Failures in Business Data Processing—and How to Avoid Them." Businessmen participating in the course will have the opportunity to analyze actual experiences of large and small companies and thereby learn how to avoid many of their extravagant "experiments" with automatic data processing. The European series of courses will be entitled "Course on Management for Automatic Data Processing."

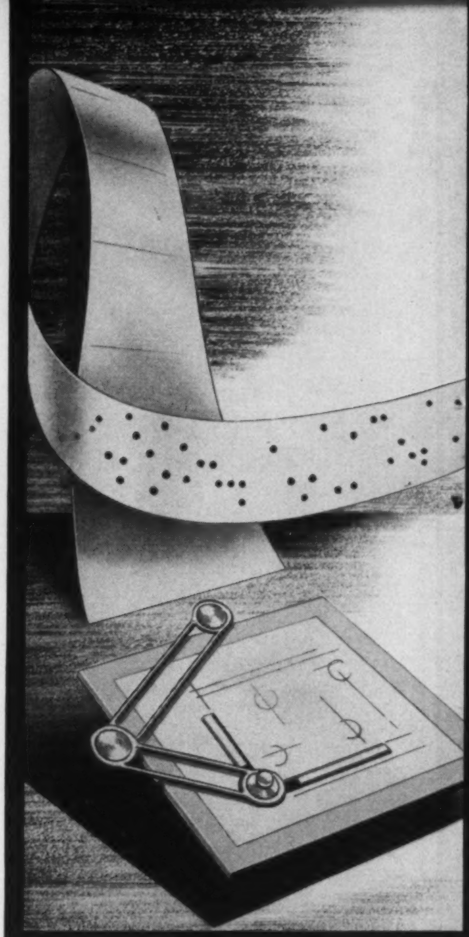
APPOINTMENT of **Clayton H. VanderMeer** as special assistant to the manager of sales engineering has been announced by Rapids-Standard Co. Inc. The appointment underscores the company's recognition of the growing need of automatic control of materials handling.

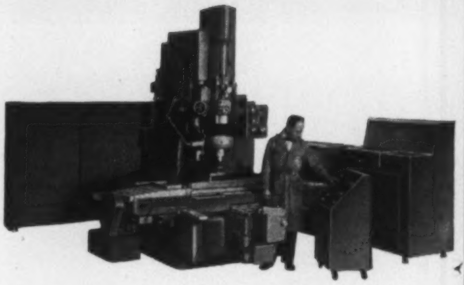
In his new capacity VanderMeer will be in charge of a new Controls Group which will assist other groups in the sales engineering organization in solving control problems that arise on various installations. He will be working with all types of automatic control devices used with the Rapistan line of conveyors and other materials handling equipment. An electrical engineering graduate of Michigan State University, VanderMeer brings to the company more than 18 years of electrical and electronic engineering experience.

Powder Metallurgy Process Makes High Density Iron Alloys

PRODUCTION of precision metal parts at a fraction of the time and cost of conventional machining methods is now possible with a new powder metallurgy process developed by P. R. Mallory & Co. Inc. The company has succeeded in producing a variety of iron alloy powders of closely controlled particle size and particle size distribution. These powders make it feasible to consistently fabricate structural parts with densities and strengths comparable to wrought alloys.

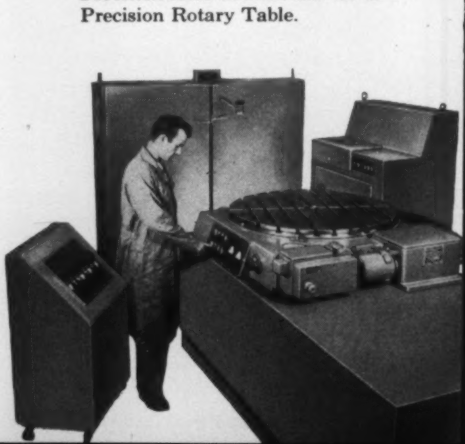
The new process eliminates expensive techniques such as copper infiltration, multiple pressing, sintering, and hot pressing which are





OTHER P&W NUMERICALLY CONTROLLED MACHINE TOOLS

. . . include the No. 2E Vertical Precision Hole Grinder and the 42" Precision Rotary Table.

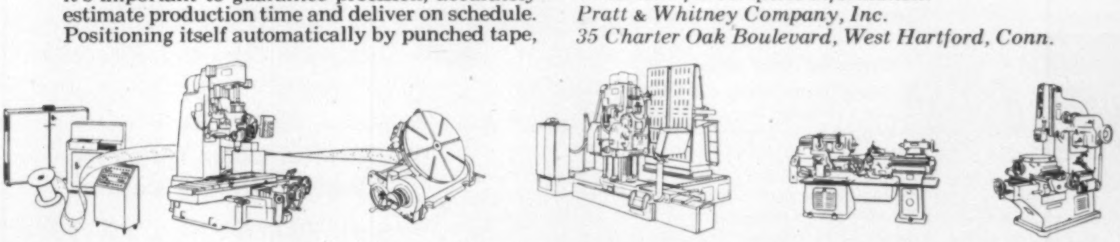


PRECISION JIG BORING TIME CUT 90% . . .

. . . WITH P&W NUMERICAL CONTROL! Precision work put on *predictable* production schedules, completed in as little as 1/10 the time required by previous methods. Costly human errors are eliminated. Positioning accurate to "tenths" absolutely guaranteed. These benefits are reported by Dexter Tool Company of Hazel Park, Michigan, since installing a Pratt & Whitney Numerically Controlled Jig Borer. Dexter produces precision aircraft and automotive components. Work involves 6 to 50 identically machined parts, and it's important to guarantee precision, accurately estimate production time and deliver on schedule. Positioning itself automatically by punched tape, the Numerically Controlled Jig Borer handles "tenths" limits as fast and surely as ordinary work. A Dexter spokesman states, "We think the P&W 2E Numerical is the greatest single improvement in machine tooling. It's the ultimate."

Today, "tenths" limits are common, yet profitable operation demands that you produce faster than ever before. Pratt & Whitney Machine Tools with Numerical Control can provide the right answer for you!

Write now for complete information.
Pratt & Whitney Company, Inc.
35 Charter Oak Boulevard, West Hartford, Conn.

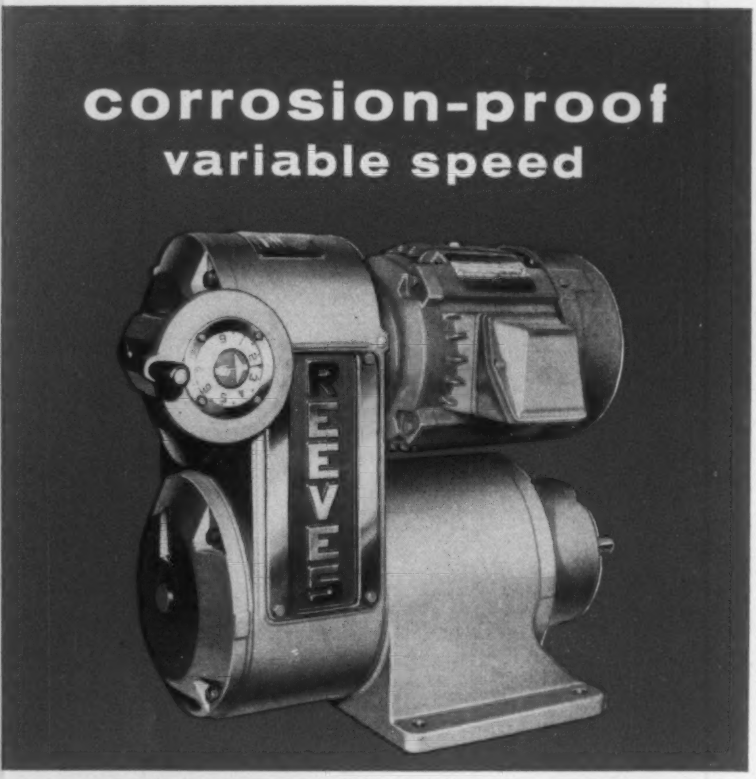

NUMERICAL CONTROL . . . JIG BORERS . . . ROTARY TABLES . . . KELLER MACHINES . . . LATHES . . . VERTICAL SHAPERS

PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS

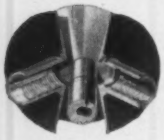
Circle 664 on Page 17



REEVES® *Vari-Speed MOTODRIVE*

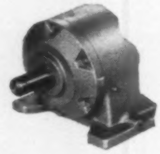
● Put a halt to high replacement costs in corrosive atmosphere with this complete variable speed power package . . . by REEVES.

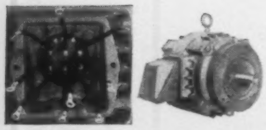
Available from ¼ through 5 hp., the 100, 200 and 300 size Motodrives are resistant to most acids, gasses and corrosive dusts. They feature a wide speed range . . . up to 10:1 with gear ratios from 1.17:1 to 195:1 . . . and provide infinitely variable speeds in hundreds of standard assemblies to fit nearly any space requirement.



Corrosion-Proof Disc Assemblies
Corrosion resistant cast iron; Exclusive REEVES "close grooving"—for positive disc lubrication.

Corrosion-Proof Gear Reducers
Cast iron gearbox and head; shaft oil seal—double tip neoprene; leak proof vent plug.



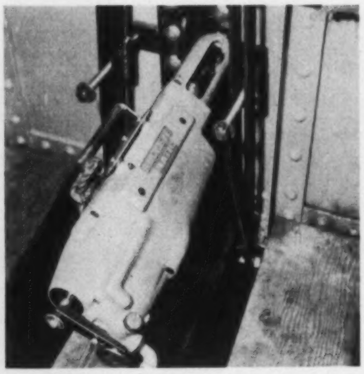


Corrosion-Proof Motor
Solid cast iron housing and fan—fully sealed cast iron conduit box—motor lead gasket seals off motor windings.

Fully sealed cast iron Motodrive case and inspection plates protect operating internals—lifetime stainless steel nameplates and identification plates—zinc plated Hexhead capscrews throughout. Write for Bulletin AN34-M578.

REEVES PULLEY COMPANY
Division of **RELIANCE** ELECTRIC AND ENGINEERING CO.
Columbus, Indiana

Circle 665 on Page 17



PORTABLE, mechanically fed, automatic drill has been developed by Buckeye Tools Corp. Designed for applications where drilling is done at several points on a large workpiece, the new tool operates through a complete drilling cycle automatically—including retraction and stopping. Rating is 1½ inch dia. in steel with a maximum stroke of 6 inches which can be adjusted downward by a micrometer screw. Mechanical feed insures forward progress of the drill as long as the drill rotates. Overload relief mechanism automatically starts retraction and shutoff if an obstruction or broken drill subjects the work spindle to an overload thrust condition.

usually required to produce high density parts. By a series of carefully controlled thermal, physical-chemical, and mechanical steps, the process arrives at raw materials which can be converted by a single pressing to many iron alloy compositions which are at least 95 per cent dense. All alloy powders exhibit excellent green strength which permits them to be compacted at high rates of production in automatic presses.

Mallory has built a pilot plant in Indianapolis to evaluate the performance of the new alloys in rugged applications. Samples have already been produced for a number of companies. Eventually, many precision parts required by industry —such as gears, cams, levers, pawls, and ratchets—will be produced from the new alloys at substantial savings in time and cost.

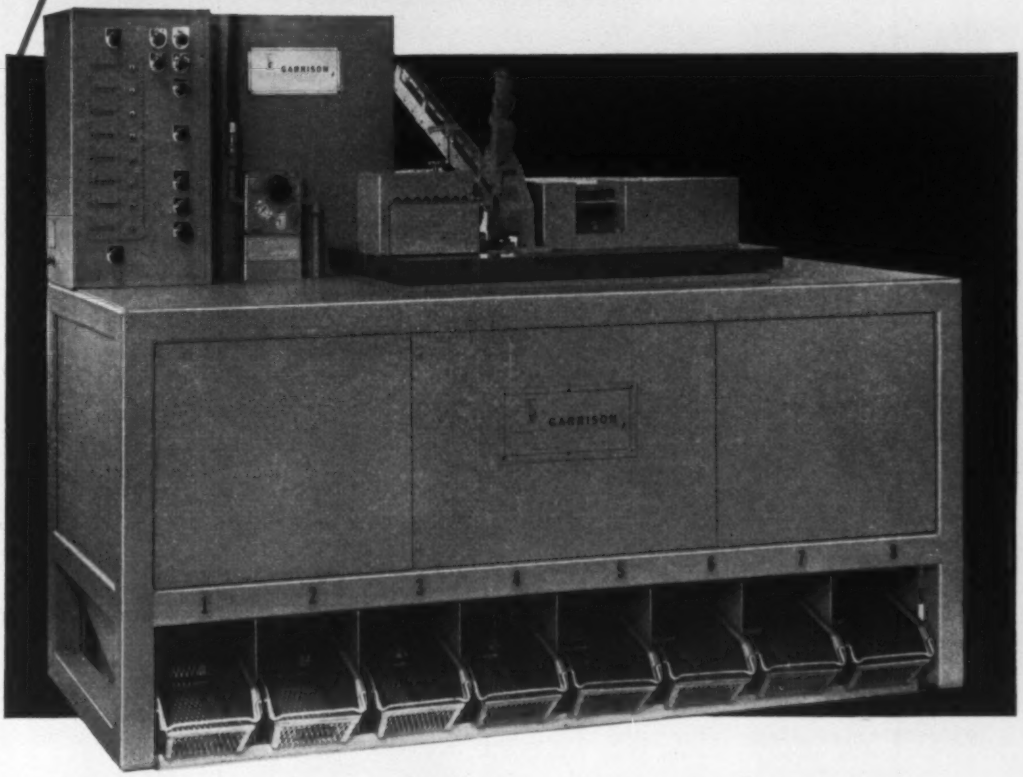
Automatic Sign Typewriter Replaces Manual Machine

AUTOMATIC sign and display typewriter with type sizes ranging up to two inches has been announced by Reynolds Printasign Co. The new machine is designed to print advertising and industrial items such as display cards, flip

DESIGNERS
BUILDERS

PRODUCTION ENGINEERED BY
GARRISON
GAGING MACHINE

- High Capacity
- Flexibility
- Speed
- Economy



1200 parts per hour — Gaged, Sorted and Counted

This machine, specially designed and built by GARRISON gages, sorts, and counts Side Gears, Crown Pinions and Clutch Rings weighing up to 2 pounds each into eight correct size categories at the rate of 1200 per hour. Designed so that with quickly interchangeable tooling, a wide variety of other gear and non-gear parts can be handled automatically at high speeds consistent with size and weight of the parts. EXCLUSIVE FEATURES:—Minimum Maintenance—Mechanical Operation—Standard Electrical Components—No Electronic Units—110 Volts A.C., 200/250 Watts—70 P.S.I. Air—Sound Conditioned—Welded Constructon—Tamper Proof Counters—Built-In Garrison Quality and Reliability.

IF YOU HAVE A PRODUCTION PROBLEM—Nobody Offers You Engineering Know-How Like Garrison. When you want a prompt, economical solution to a manufacturing production problem, or, when you want to cut the cost of inspection, assembly or handling, our engineers are specially well qualified to design and build the equipment necessary to *exactly* meet your requirements.

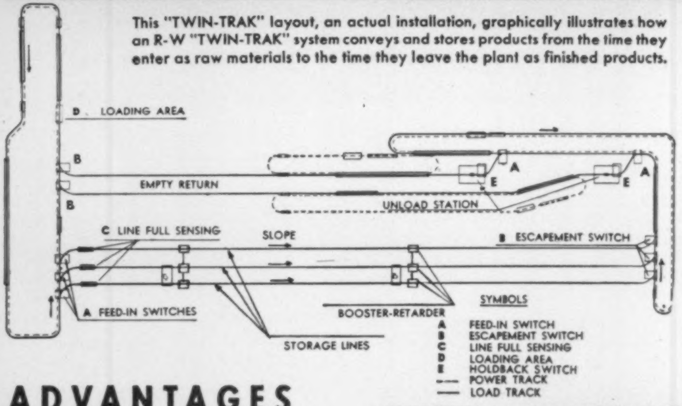
Creative Engineering and Manufacturing Since 1904

GARRISON MACHINE WORKS, Inc. • Dayton 4, Ohio U.S.A.

GARRISON

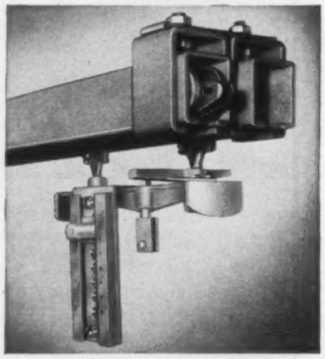
for an efficient automatic-selective conveying system ... SPECIFY THE R-W
TWIN-TRAK
TRADEMARK
OVERHEAD automatic DISPATCH SYSTEMS

This "TWIN-TRAK" layout, an actual installation, graphically illustrates how an R-W "TWIN-TRAK" system conveys and stores products from the time they enter as raw materials to the time they leave the plant as finished products.


D LOADING AREA
B
EMPTY RETURN
B
A
E
A
E
UNLOAD STATION
C LINE FULL SENSING
SLOPE
B ESCAPEMENT SWITCH
A FEED-IN SWITCHES
BOOSTER-RETARDER
STORAGE LINES
SYMBOLS
A FEED-IN SWITCH
B ESCAPEMENT SWITCH
C LINE FULL SENSING
D LOADING AREA
E HOLDBACK SWITCH
POWER TRACK
LOAD TRACK

ADVANTAGES

- **Provides trouble-free, automotive-selective control over product movement through entire plant.**
- **Economical and practical . . . provides added storage space . . . saves time, labor and money.**
- **Automatically supplies component parts to work stations from storage banks or lines.**
- **Economical to install . . . extremely flexible . . . quickly and economically revised or modified to meet your changing needs or future expansion plans.**
- **Ideal for conveying and dispatching products in multiple story buildings.**
- **Designed, manufactured and backed by the leading firm in this field for over 75 years.**



An R-W "TWIN-TRAK" System consists of one or more power tracks and as many storage or free tracks as desired. Available with efficient, economical manual or electronic selective controls designed to effectively meet your specific requirements.

WRITE TODAY

for complete information . . . request Catalog F-192.

Leading manufacturer of Track Hangers, all types of hardware and Electric Door Operators for over 75 years.

Richards-Wilcox
MANUFACTURING COMPANY
Materials Handling Division

RICHARDS-WILCOX R&W AURORA

417 W. THIRD STREET, AURORA, ILLINOIS • Branches in Principal Cities

Circle 667 on Page 17

MAGNETIC tape recorder has been developed by the Instrumentation Div., Ampex Corp., to record photographs on tape. Picture is fed into the recorder in the form of an output signal from a standard facsimile transmitter. Taped signal may then be sent to other machines at speeds faster than that of ordinary facsimile transmission. Upon playback, the recorder feeds a signal into a facsimile receiver and reproduces the original picture with full clarity and detail.

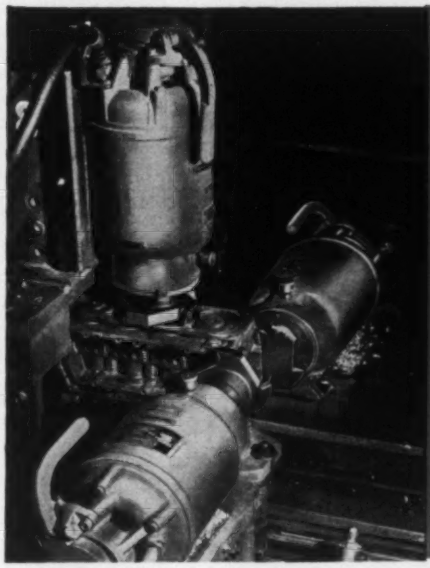
charts, name plates, and motion picture titles.

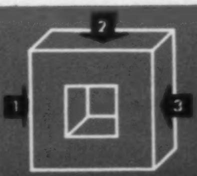
Lightweight aluminum, supplied by Aluminum Co. of America, is used for 75 per cent of the typewriter parts assuring ease of operation and portability. Operating on the typewriter principle, the unit contains type in several different sizes and faces. In addition to being used in retail stores, the sign typewriter has many probable applications in industry in the preparation of visual training and lecture aids.

CUSTOM DESIGNED automatic materials handling systems for rapid and economical handling of paper rolls with weights of up to 2000 pounds are discussed in a four-page bulletin offered by Gifford-Wood Co. The latest advances in horizontal and vertical conveying are discussed along with automatic control and safety features. Seventeen photographs illustrate the bulletin with views of installations at various newspaper plants.

Tap Tool Swages Threads

NEW tool for tapping threads in ductile materials has been developed by Besly-Welles Corp. Unlike conventional tools the new X-press tap





MILL UP TO 3 SIDES AT ONE TIME

WITH

Onsrud®

A-242S

TRI-WAY MILLING MACHINE

a member of the COMPLETE family of Onsrud Milling Machines designed specifically for Aluminum and related nonferrous milling

PROOF of the tremendous productivity of Onsrud milling machines designed for nonferrous milling is shown by this production study. This kind of production is typical of the advantages that can be yours with every Onsrud milling machine.

3 PARTS PER MINUTE!

THE PART: Outboard motor cylinder block, aluminum alloy casting 7″ wide x 13″ long and 6″ high.

THE MACHINE: Onsrud A-242S Tri-Way Milling Machine with one vertical and two horizontal opposed milling heads.

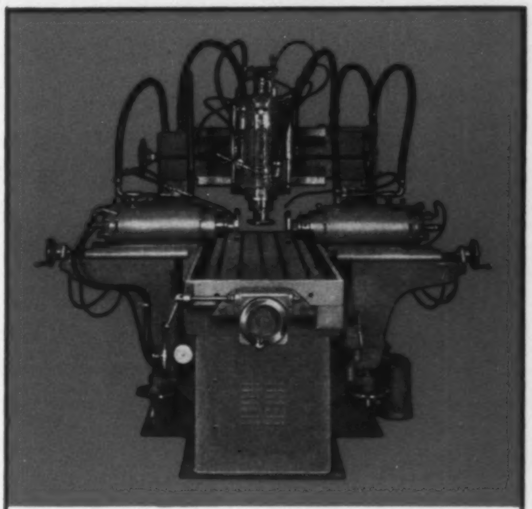
OPERATION: Machine three sides of block in on set-up and in one pass.

ACCURACY: Flatness tolerance ± 0.0003″. Parallel tolerance ± 0.001″.

PRODUCTION: Three parts per minute.

CUTTER LIFE: 500 to 1,000 parts per regrind.

Onsrud high speed milling production is only possible because Onsrud machines are designed and built specifically for milling aluminum and related nonferrous metals. The cutter speeds and feeds are exactly right to give smooth finish and precision . . . at super-high production speeds.



Onsrud A-242S Tri-Way Milling Machine, for milling up to three sides at one time, of any part square or rectangular in cross section. Planer type table with variable feed up to 258 IPM. Cutter motors Onsrud 10 HP, 3,600 RPM, liquid cooled.

Write for Information

Let us give you complete data on the Onsrud A-242S Tri-Way Milling Machine... and all other Onsrud milling machines for nonferrous metal milling. Get the facts on these proved, high speed production machines. Your inquiry is cordially invited.

ONSRUD
MACHINE WORKS, INC.
machine tool division
7714 Lehigh Avenue
Niles 31, Illinois

Onsrud® HIGH SPEED **MILLING MACHINES** FOR ALUMINUM AND RELATED NONFERROUS METAL MILLING

For doing things *better* by doing things *differently!*

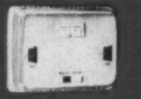
Circle 668 on Page 17

You're covered across the board

when you use General Controls' line of quality automatic controls

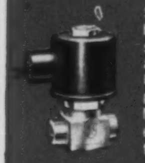
In heating, power generation or process regulation, plant engineers everywhere have found that it pays to check first with General Controls. General Controls' comprehensive line ranges from the simplest time switch or thermostat to advanced programmers and recording controllers.

T-231 ROOM THERMOSTATS



For all heating and/or cooling applications. High response to radiant and convected heat. Snap action or mercury switch models. For millivolt, line or low voltages.

K-27 MAGNETIC VALVE



Stainless steel for high sulphur fuels, syrups, juices, acids, alkalis, etc. Pressures to 300 psi. Midget size. Multi-poised — operates in any position.

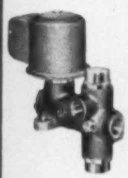
INDUSTRIAL INSTRUMENTS

Pneumatic Recording Controller in cast aluminum case. Assemblies interchangeable. One of General Controls' wide line of pneumatic indicators, recorders and controllers.

PRECISION POTENTIOMETERS

Available to complement automatic controls for automation and instrumentation. Rotary, linear and sector types in miniature sizes. Greater resolution and exceptional stability.

K-123 MAGNETIC VALVE



3 way—for normally open or normally closed directional control and mixer applications—on pneumatic or hydraulic operated devices, machine tools, etc.

B-55G GAS VALVE

Governor Type for "on-off," high-low modulating and air damper control. Slow opening diaphragm. For gas flow to industrial boilers and furnaces.

COMBUSTION CONTROLS

For ultimate operating efficiency of commercial and industrial boilers. Conserves fuel, reduces stack losses, keeps heat in the boiler and provides more efficient heat transfer to boiler water.

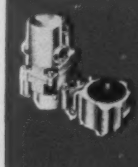
HYDRAMOTOR (motor-operated) VALVES

Wide range of types in complete range of pipe sizes and body styles to provide safe, dependable, durable answer to all liquid transfer problems.

COUNTERS

Complete line of counting devices, automatic batch counters and counter actuators from new Production Instrument Division. Electric, manual, stroke, rotary and mercury reset models.

MOTOR-OPERATED GATE VALVE



Typical of precision-built controls designed and produced to rigid military and commercial specs for highly complex systems of modern aircraft and guided missile.

GENERAL CONTROLS

Manufacturers of America's Finest Automatic Controls for Home, Industry and the Military
Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada
Six Plants—42 factory branch offices serving the United States and Canada

Circle 669 on Page 17

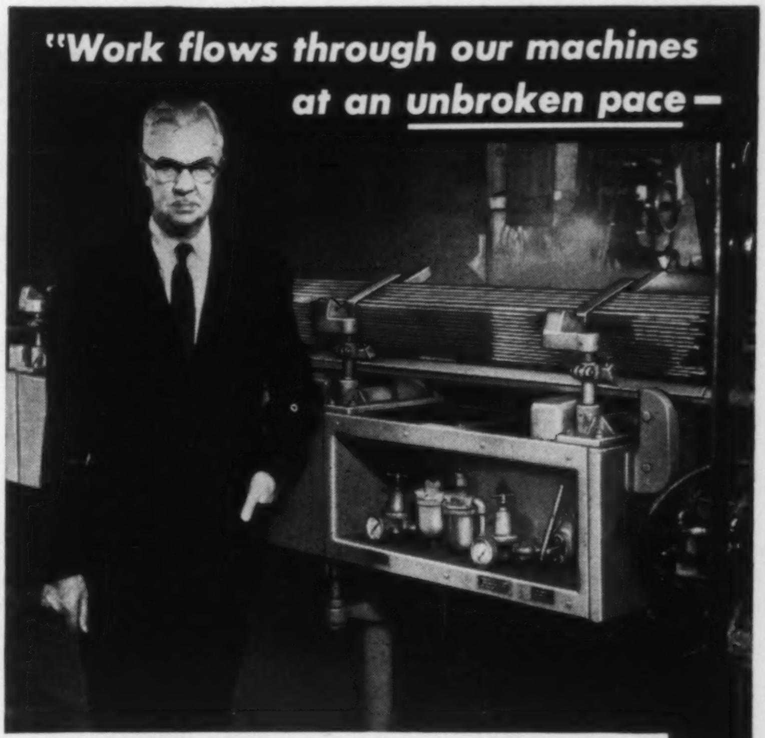
cold forms or swages threads in materials such as aluminum, zinc, brass, copper, lead, leaded steels, and other soft metals.

The X-press tap forms threads by rolling rather than cutting the metal and time consuming air cleaning of chips is unnecessary. In most materials, recommended speeds are far greater than the speeds called for when using ordinary cutting taps. As a result, the number of pieces per hour is substantially increased and cycling time on automatic tappers and screw machines can be reduced.

TAPE-CONTROLLED program unit has been developed by Electrosystems Inc., subsidiary of Royal Industries Inc., to automatically operate industrial drill presses and other machine tools. Information from punched tape is read by the console unit and controls the selection of tools and part positioning. The programming of the tape is extremely simple and does not require the use of a computer.

SPOTLIGHTING PEOPLE

Winfield Heinz appointed manager of engineering of the Instrumentation Div., Ampex Corp. . . . **Edward E. Kirkham** named chief development engineer and head of Experimental Dept. of the machinery division of Pratt & Whitney Co. Inc. . . . **J. Frank Forster** elected president of Vickers Inc., a division of Sperry Rand Corp. . . . **James E. Paumier** appointed general superintendent of the Canton Div., E. W. Bliss Co. . . . **R. E. Kirby** appointed manager of the Baltimore electronics operation of Westinghouse Electric Corp. . . . **R. Victor Harris** appointed general manager of Instrument Div., Perkin-Elmer Corp. . . . **William T. Griffiths** elected president of Anders-Lykens Corp., a sub-



"Work flows through our machines at an unbroken pace—

with **LIPE Automatic**

MAGAZINE LOADING BAR FEEDS"

says Factory Superintendent Dan Thomas*

Our production figures ran all over the chart when we were using stock-feeding devices equipped with feed-fingers. In addition to tricky set-ups and frequent re-sets, we lost a lot of polished stock which had to be scrapped or refinished when scratched or marred by feed-fingers. Operators suffered fatigue and strain trying to stay on top of these mechanical "prima donnas." Production suffered from the slow-downs resulting from all these factors.

Our first test run of a Lipe A.M.L. Bar Feed proved that every one of these "bugs" could be eliminated—permanently. It fed stock continuously . . . without feed-fingers . . . with no repeat motion for feed-outs . . . no down-time for adjustments or remnant removal. There was no cutting air: From 7:30 to 4:00 every turn of the spindles produced *work* . . . at a day-in-day-out delivery of 58% higher production! Our entire department is now equipped with Lipe A.M.L. Bar Feeds.

WRITE or WIRE for a FREE Lipe Sales Engineering estimate of production increases, savings and amortization time of Lipe A.M.L. Bar Feeds in your production layout.

*Photographer's models and pseudonyms used to protect company identity and confidential information.

Lipe-ROLLWAY
CORPORATION
SYRACUSE 1, N. Y.

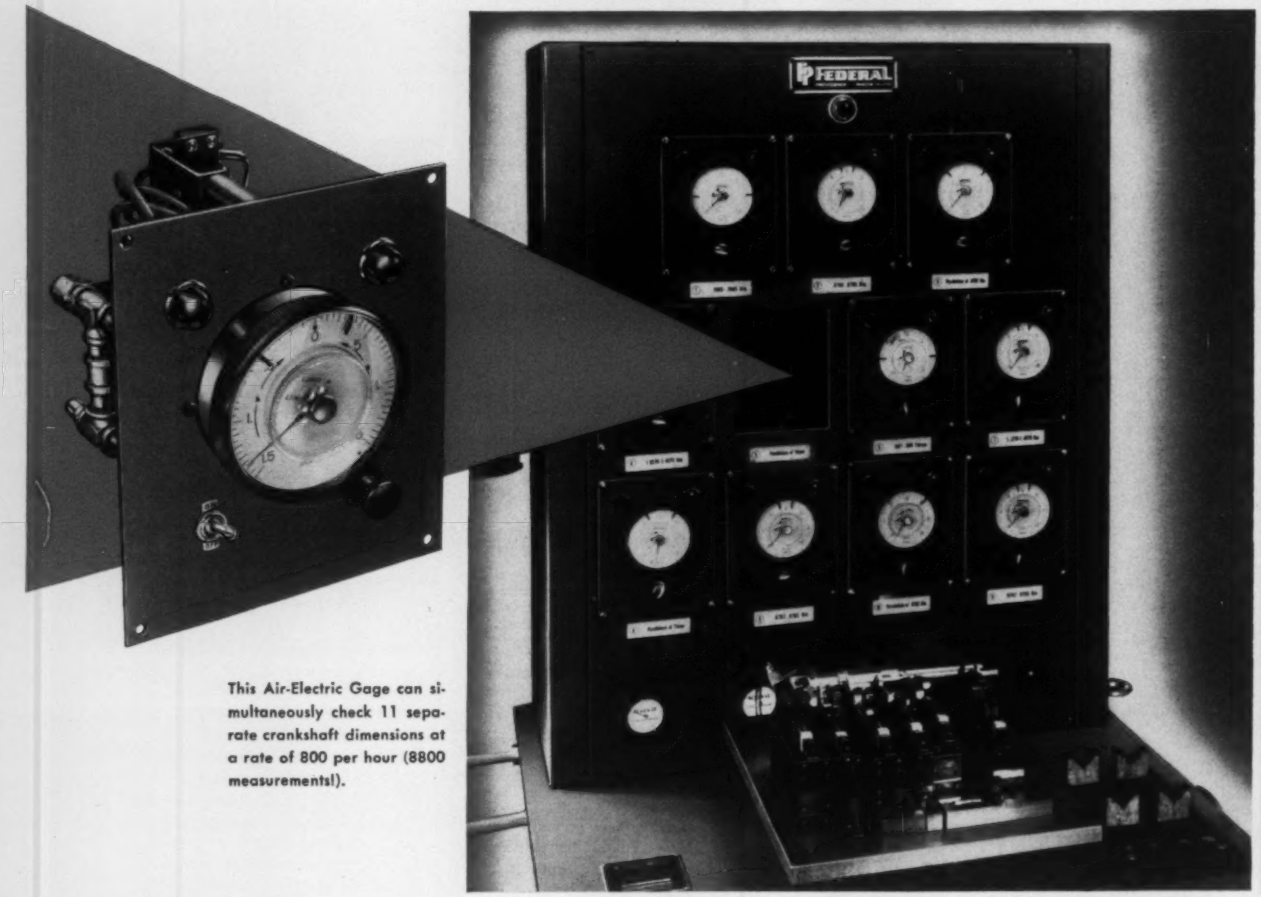
BAR FEEDS • HEAVY-DUTY AUTOMOTIVE CLUTCHES • PORTABLE POWER HACK SAWS

Circle 670 on Page 17

WHAT A DIFFERENCE

● MODULAR DESIGN . . .

Meter switch units are standardized for lower cost and self-contained for quick interchangeability. *Result* — lower gage price, gage downtime virtually eliminated.



This Air-Electric Gage can simultaneously check 11 separate crankshaft dimensions at a rate of 800 per hour (8800 measurements!).

There isn't a production line gage in use that doesn't need care and service. Good design keeps this to a practical minimum. However, few, if any, designs have been aimed deliberately at reducing the amount of time needed to effect service or replacement . . . a critical consideration in production costs. But Federal's MODULAR design arranges construction so that gage downtime is reduced to moments. Only four screws, two finger-tight air hose connections and an electrical connector are involved in replacement of one meter unit by another. Then the replaced unit can be serviced at the bench when convenient. And, with Federal's one-master air system, setting the replacement unit takes only *10 seconds.* Even though the overall gage design is special to suit the particular requirements, these MODULAR units are standardized, which means lower first cost.

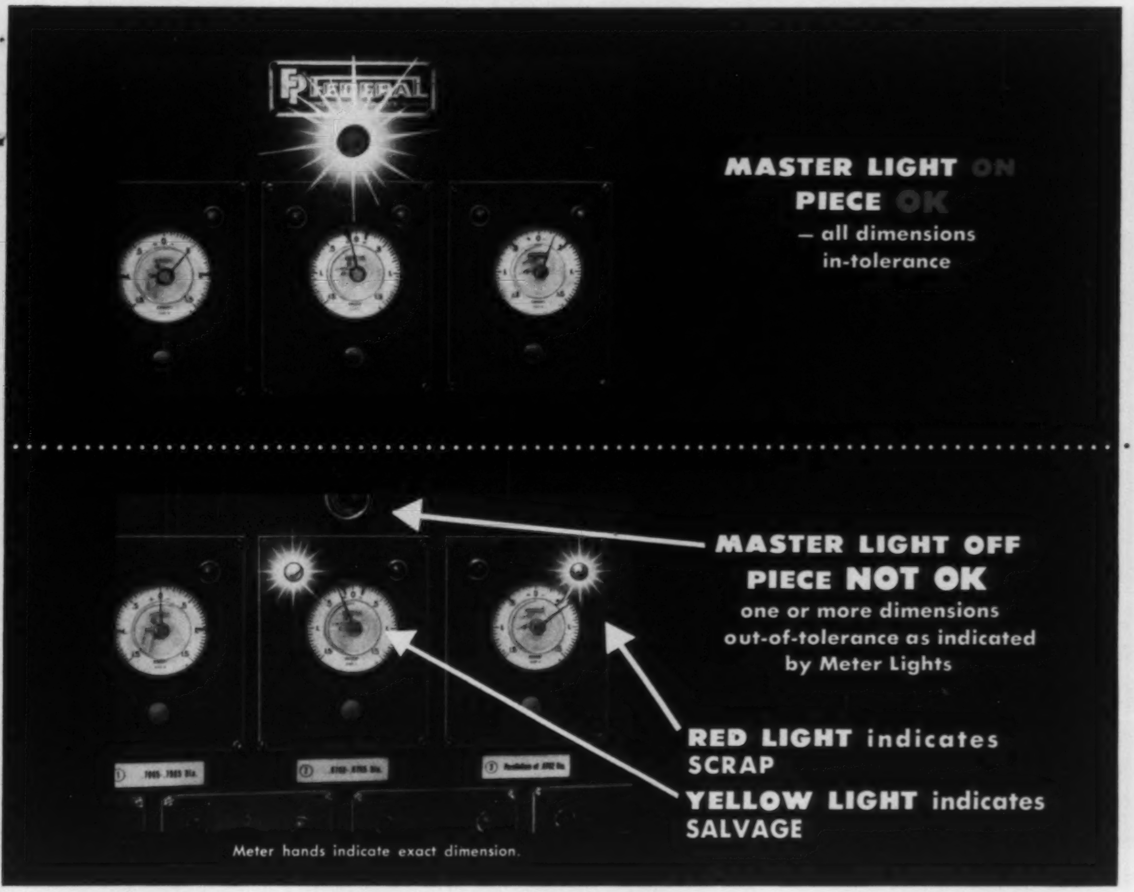
Get in touch with your Federal representative and investigate MODULAR design further . . . in terms of your own needs.

FEDERAL PRODUCTS CORPORATION
8393 Eddy Street, Providence 1, R. I.

IN GAGING ECONOMY!

● MASTER LIGHT CONCEPT...

Lets gage's accuracy, rather than operator's judgment, determine piece acceptability. *Result* — gaging speed doubled, errors eliminated.



MASTER LIGHT ON
PIECE OK
— all dimensions in-tolerance

MASTER LIGHT OFF
PIECE NOT OK
one or more dimensions out-of-tolerance as indicated by Meter Lights

RED LIGHT indicates SCRAP
YELLOW LIGHT indicates SALVAGE

Meter hands indicate exact dimension.

Ordinarily, a multiple dimension gage requires the operator to determine—from scanning a row of bobbins or meters—the dimensional conformance of the piece being gaged. To keep up with the production pace, this must be done quickly . . . often leading to errors, especially in borderline decisions. Also, the fatigue factor in this type of gaging is high, accounting for additional inspection errors.

But Federal's MASTER LIGHT concept eliminates these errors by making acceptability decisions for the operator . . . without hesitation . . . without prejudice . . . without fatigue . . . *without error.* It does more than that, actually. If one or more of the dimensions are "out", the gage spots these and tells the operator instantly whether the piece must be scrapped or whether it can be reworked. Small wonder that this method can increase gaging speed over 100% . . . an increase that can easily mean needing only one gage-operator combination, instead of two, in order to keep pace with production needs.

Another advance that means more economy when you do business with Federal. Talk it over with your Federal representative soon.

Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

Circle 671 on Page 17

A NEW LIGHT-DUTY TROLLEY CONVEYER . . . ENGINEERED AND STANDARDIZED BY

MATHEWS

A #232 Trolley Conveyer Applied for painting, drying and storage of miscellaneous parts.

This light-duty Trolley Conveyer has several features which make it a leader in the field of overhead conveying. It is comparatively easy to install, with hanger-rod and angle hanger supports available to meet any supporting requirements. Standard turns, vertical bends, and takeup assemblies are made in sizes and types to fit even the most difficult layout.

The drive units have a wide range of capacities and horsepowers, with conveyer speeds ranging from one to fifty feet per minute.

The #232 wheel was specifically designed for trolley conveyer service and is an outstanding performer. This equipment is priced reasonably and is available from stock, being assembled from standard parts throughout.

MATHEWS TYPE 232

Write for Bulletin T-58 today.

MATHEWS CONVEYER COMPANY

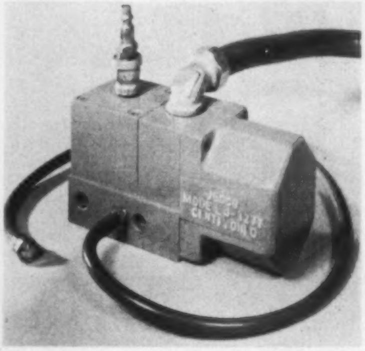
GENERAL OFFICES . . . . ELLWOOD CITY, PENNSYLVANIA
PACIFIC COAST DIV. . . . MATHEWS CONVEYER COMPANY WEST COAST, SAN CARLOS, CALIFORNIA
CANADIAN DIVISION . MATHEWS CONVEYER COMPANY, LTD., PORT HOPE, ONTARIO.

MCC

MATHEWS

Over Fifty Years of Leadership in Mechanized Handling

Circle 673 on Page 17



SELF-CONTAINED pneumatic proximity transducer capable of providing an electrical signal from the presence of a part near the pick-up nozzle has been developed by Jessup Engineering & Development Co. Power input is factory air at 70 to 100 psi and output is fed to an integral pneumatic pressure switch. The unit will read the presence of light or fragile parts as well as those which are non-magnetic. The unit is available in five models with pick-up distances varying from 0.001 to 0.016 inch.

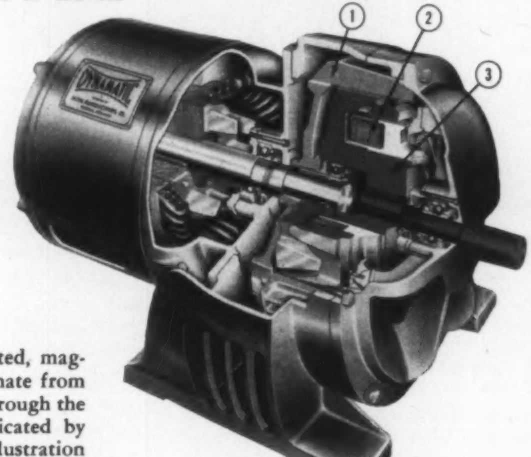
sidiary of Milton Roy Co. . . . **John P. Klembeth** appointed product engineering manager of Milton Roy Co. . . . **Horace Keech** named plant manager for Conoflow Corp. . . . **Alexander Ferko** appointed manager of Flat Products Div., Lombard Corp. . . . **E. V. Collins** appointed plant engineer for U. S. Metal Coatings Co. Inc. . . . **Eugene V. Cyran** elected president of Modern Engineering Service Co. . . . **Edward P. Russell** appointed Western Div. manager of Chainveyor Corp. . . . **William C. McDonald** made vice president in charge of engineering and manufacturing at Non-Linear Systems Inc. . . . **George D. Cowie** appointed assistant chief engineer of Plymouth Div., Chrysler Corp. . . . **Sheldon E. Wells** and **George F. Bateson Sr.** elected to the board of directors of Lombard Corp. . . . **Alfred C. Wenzel** named production manager of Republic Flow Meters Co., a subsidiary of Rockwell Mfg. Co. . . . **O. B. Schier II** appointed secretary of the American Society of Mechanical Engineers. . . . **Joseph M. Martin Sr.** named manager of design department and **Paul L. Ashway** appointed manager of fabrication services for Datalab, a division of Consolidated Electrodynamics Corp. . . . **James F. Connaughton** elected president of Wheelabrator Corp. . . . **William A. Surzik** named plant manager for Cleveland Instrument Co. . . . **A. J. Talamini Jr.**

HOW DYNAMATIC® Drives Provide Infinitely Adjustable Speed with AC Power

Dynamatic Ajusto-Spede® and Dynaspede® Drives operate from an alternating current power source and are infinitely adjustable from zero RPM to full output speed. Accurate control of output speed is obtained by varying the current in a single field coil.

Each Dynamatic Drive consists of a constant speed AC motor and an eddy-current coupling. Torque developed in the motor is transmitted through the coupling by electromagnetic attraction between its driving and driven members.

The driving member, or drum (1), is mounted on the end of the motor shaft and surrounds the rotor, or driven member (3). The drum is free to rotate independently of the rotor until current is applied to the stationary field coil (2).



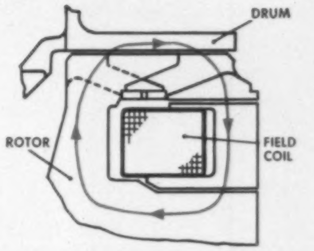
1. **Input Drum Assembly**
2. **Stationary Field Assembly**
3. **Output Rotor Assembly**

As the field coil is excited, magnetic lines of force emanate from the field coil and flow through the rotor and drum as indicated by arrows in cross-section illustration (A). Poles on the rotor adjacent to the smooth drum concentrate the lines of force into localized areas of "high flux" density in the drum's inner surface, shown in illustration (B). As the drum rotates about the rotor, these high flux areas sweep the inner surface of the drum, causing a variation of flux density that generates an eddy-current field in the drum's inner surface. Magnetic attraction between this eddy-current field and the rotor poles causes the rotor to rotate with the drum.

The torque transmitted from the drum to the rotor varies with the current applied to the field coil and with the "slip", or difference in speeds between the drum and rotor. Speed control with eddy-current equipment is obtained with a control system that adjusts field coil current to deliver the required torque at the desired slip.

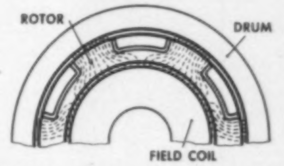
The control systems used with Dynamatic Eddy-Current Equipment operate on alternating current and require no special power source. Because of the low power required for field coil excitation, rectifying of field coil current is easily accomplished electronically. Expensive motor-generator sets are not required.

The control features available with Dynamatic Eddy-Current Equipment include constant speed regulation, acceleration control, torque regulation, cascading of multiple units, inching and threading, and numerous others as required by individual applications. Dynamatic Eddy-Current Equipment is ideally suited to automatic control.



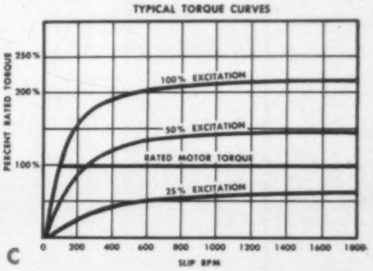
A

Flow of magnetic lines of force through rotor, drum, and stationary field.



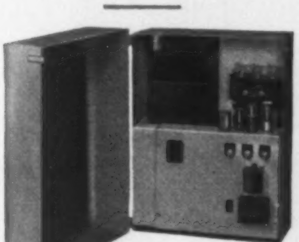
B

Concentration of magnetic lines of force by the rotor poles.



C

Typical torque curves show torque at various values of excitation. The horizontal line is rated motor torque.



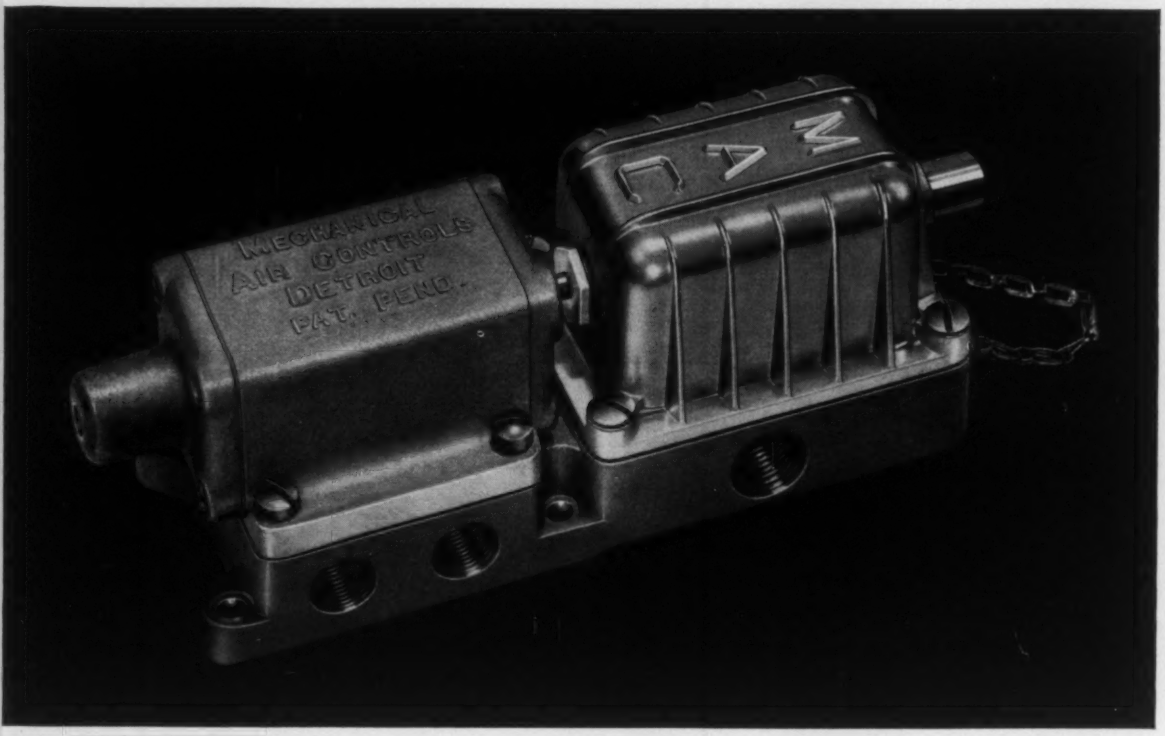
D

The electronic control systems used with Dynamatic Eddy-Current Equipment do not require a special power source or motor-generator sets.

Send for your copy of Bulletin D-582 which gives detailed information on Dynamatic Eddy-Current Equipment.

EATON

—DYNAMATIC DIVISION—
MANUFACTURING COMPANY
CLEVELAND, OHIO



When is an air valve truly J.I.C.?

Only when it meets *all* J.I.C. requirements. To our knowledge this new MAC series *alone* can pass the test completely.

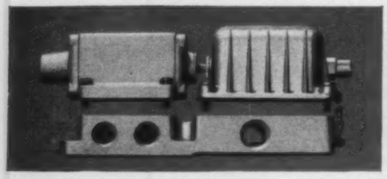
Example #1. It is the only valve with completely independent body and solenoid. Either can be removed separately from the base without disturbing the other. This eliminates confusion of responsibility between electrical repair and mechanical repair . . . greatly simplifies maintenance and repair.

Example #2. Cover assembly contains a manual overide operator which includes a "lock-in" position for safety. Cover is dust-proof, splash-proof, chained to base. Solenoid is inoperative when cover is removed.

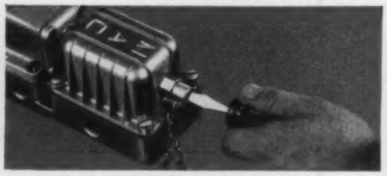
Example #3. The base contains an integral conduit box with threaded conduit connections. Ample space . . . easier wiring . . . more compact valve.

Extra features in this J.I.C. series include the MACsolenoid. It is positively shock-resistant mounted . . . has no metal-to-metal contact with stationary parts . . . by actual test operates nonstop and *without any failures* millions of cycles longer than other solenoids.

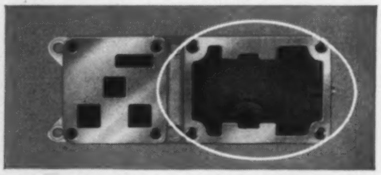
Compare this new MAC series with any other "J.I.C." valve. They alone meet *or surpass* every J.I.C. specification. They are typical of the engineering excellence you find in all MAC valves. For information call a MAC representative listed at the right, or write direct.



1 Independent body, solenoid, base



2 Safe, manual overide operator



3 Integral conduit box in base

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park, Detroit 37, Michigan

MAC

Circle 675 on Page 17

PHONE YOUR NEARBY "MAC" REPRESENTATIVE FOR DATA AND DELIVERY

ARKANSAS
Branch-Merwin Tool Specialists, 477 N. Bellevue, Memphis 5, Tenn., BRoadway 8-6102
CALIFORNIA
OAKLAND 8—The Rucker Co., 4700 San Pablo Ave., OLympic 3-5221
SOUTH GATE—The Rucker Co., 4956 Firestone Blvd., LOrain 4-2521
FLORIDA
MIAMI SPRINGS—Aero Hardware & Supply Inc., 4301 Northwest 36th St., TUxedo 8-2414
ILLINOIS AND IOWA
CHICAGO 6—Walter Norris Engineering Co., Civic Opera Bldg., 20 N. Wacker Dr., STate 2-2804
INDIANA
EVANSVILLE 14—Neff Engineering Co., 2509 Washington Ave., GReenleaf 7-4141
FORT WAYNE 3—Neff Engineering Co., Station A, P.O. Box 2001, 2339 Crescent Ave., EAstbrook 7391
INDIANAPOLIS 2—Neff Engineering Co., 1955 Central Ave., WAlnut 5-5311
SOUTH BEND—Neff Engineering Co., 707 South Eddy St., ATlantic 7-5655
MARYLAND (and Dist. of Columbia)
BALTIMORE 18—N. B. Cochrane Co., 100 E. 20th St., HOpkins 7-4884
MASSACHUSETTS (and New England)
BOSTON 34—Electrical Apparatus Co., Inc., 1200 Soldiers Field Rd., STadium 2-7440
MICHIGAN
BAY CITY—Fred Kober, 506 So. Chilson St., TWinbrook 2-2629
FLINT 2—Kober Sales Engineering Co., 1115 Root St., CEdar 2-7165
WESTERN MICHIGAN—Everett Adams, 17212 Sharon Road, Chesaning, Michigan, VIctor 5-3446
MINNESOTA
MINNEAPOLIS 8—Air & Hydraulic Equipment Co., 15 E. 38th St., TAylor 3-6118
MISSISSIPPI
Branch-Merwin Tool Specialists, 477 N. Bellevue, Memphis 5, Tenn., BRoadway 8-6102
MISSOURI
ST. LOUIS COUNTY—Oscar E. Jost Co., P.O. Box 6, St. Ann, HArrison 8-4488
NEW JERSEY
(**NORTHERN**) Machinery & Machine Supplies Co., Inc., 305 East 47th St., New York 17, New York, PLaza 8-0744
(**SOUTHERN**) Automation Aides, 1618 Willow Ave., Philadelphia 26, LaMott, Pennsylvania, MElrose 5-5555
NEW YORK
BUFFALO 26—C. H. Tepas Co., 137 Lamarck Drive, CIrcle 3210
NEW YORK 17—Machinery & Machine Supplies Co., Inc., 305 East 47th Street, PLaza 8-0744
OHIO
CINCINNATI 2—Fluid Power Engineering Co., 205 Keith Bldg., MAin 1-6640
CLEVELAND 9 (PARMA)—Fluid Power Engineering Co., 5451 Broadview Rd., FLorida 1-1199
OREGON
PORTLAND—The Rucker Co., 911 N. W. Hoyt St., CApitol 3-0205
PENNSYLVANIA
PHILADELPHIA 26, LaMOTT—Automation Aides, 1618 Willow Ave., MElrose 5-5555
PITTSBURGH—Machinery & Machine Supplies Co., Inc., 1307 Rutherford St., LEhigh 1-1235
TENNESSEE
MEMPHIS 5—Branch-Merwin Tool Specialists, 477 N. Bellevue, BRoadway 8-6102
TEXAS
DALLAS 35—Womack Machine Supply Co., 2010 Shea Road, FLeetwood 7-3871
WASHINGTON
SEATTLE—The Rucker Co., 1000 4th Ave., South, MAin 2783
WISCONSIN
MILWAUKEE 17—Neff Engineering Co., 5856 No. Pt. Washington Rd., Edgewood 2-1579
CANADA
MONTREAL—L. S. Tarshis & Sons, Ltd., 450 McGill St., Quebec, PLateau 2963
TORONTO—Trevor Babbs, National Time & Signal Co., 72 Shilton Rd., Agincourt, Ontario, OXford 1-4857

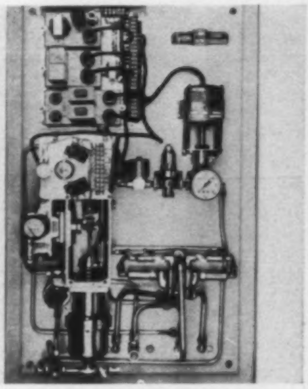
MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN
MAC

Circle 675 on Page 17

appointed director of engineering for Electro Tec Corp. . . . **John Michelotti** appointed director of operations for Clearing Machine Corp., a division of U. S. Industries Inc. . . . **Philip Rosenberg** appointed director of Mechanics Research Dept. for American Machine & Foundry Co. . . . **Robert L. Fairbank**, vice president of Towmotor Corp., elected president of the Material Handling Institute Inc. . . . **W. F. Eagan** appointed chief engineer of the control department for Allis-Chalmers Mfg. Co.

SPOTLIGHTING PRODUCTS

Lightweight transistorized dc servomechanisms, designed as accurate power-amplifying devices for use in instruments and medium power installations, are available from Advanced Research Associates Inc. . . . *Surface temperature transducers* which consist of platinum resistance thermometers that can be cemented or welded to any type surface for accurate temperature measurement are offered by Trans-Sonics Inc. . . . *Single-pole, double-throw relays* weighing only 13 grams each and designed specifically for direct application to printed circuit boards are available from American Electronics Div., American-Monarch Corp. . . . *Magnetic-particle clutches* in models ranging from 2 to 1500 inch-pounds of torque under excitations ranging from 0.8 to 8.0 watts are available from Lear Inc. . . . *Radially-installed reinforced "E-rings"* which provide high gripping strength and allow higher rpm design limits are available from Waldes Kohinoor Inc. . . . *Fluid energy mills* having no moving parts are available from Sturtevant Mill Co. The units, called Micronizers, will simultaneously dry grind and classify solids to superfine particles as small as a half-micron. . . . *Transistorized multiverters* which generate a voltage at high speed that is the product of a digital number input and a fixed or varying reference voltage are available from Packard-Bell Computer Corp.



PACKAGED control system for the remote positioning of valves and variable speed mechanisms such as throttles and rheostats has been developed by A. W. Cash Co. in conjunction with Sparton Corp. The electronic-hydraulic-pneumatic unit can control pressure, flow, surge, liquid level, proportioning, speed, and other process variables in remote locations. Signals for actuating the control unit can be received via telegraph, telephone, or private wires, or via microwave transmission.

SPOTLIGHTING PLANTS

Badger Meter Mfg. Co. has purchased Counter & Control Corp. and will operate it as a wholly-owned subsidiary. . . . **Miehle-Goss-Dexter Inc.** has entered into a contract for the acquisition of Mercury Engineering Corp. . . . **American Machine & Foundry Co.** will close its Boston electronics plant and reassign the plant's work to AMF facilities in Greenwich, Conn., and Pomona, Calif. . . . **Applied Science Corp. of Princeton** has changed the name of its Switch Div. to the ASCOP Electro-Mechanical Div. . . . **Leeds & Northrup Co.** has been awarded a contract for $450,000 worth of automatic control equipment by Hazel-Atlas Div., Continental Can Co. . . . **Weksler Instruments Corp.** is the new name for Weksler Thermometer Corp. . . . **Loma Machine Mfg. Co.** has begun the construction of an addition to its plant in Alburtis, Pa. . . . **Moore Associates Inc.** has been formed as a new electronic systems manufacturing and development company. It will specialize in the manufacture of transistorized telemetering and remote control equipment for rail, petroleum, chemical, and utilities industries. . . . **Peninsular Metal Products Corp.** has announced the conclusion of arrangements to acquire the George L. Nankervis Co., designers and manufacturers of testing equipment and metal finishing systems. . . . **Link-Belt Co.** has opened a new

IN LESS THAN 4 SECONDS

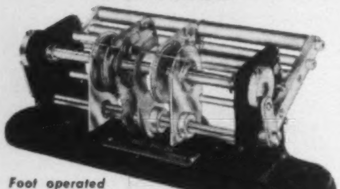
FROM THIS

TO THIS

OR THIS

WITH THE REVOLUTIONARY PRODUCTION AID TOOL!

"PIG-TAILOR"®



Foot operated
No accessories
3 minute set up

$125.00

"PIG-TAILORING"

a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

PIG-TAILORING eliminates: • Diagonal cutters • Long nose pliers • Operator judgment • 90% operator training time • Broken components • Broken leads • Short circuits from clippings • 65% chassis handling • Excessive lead tautness • Haphazard assembly methods.

PIG-TAILORING provides: • Uniform component position • Uniform marking exposure • Miniaturization spacing control • "S" leads for terminals • "U" leads for printed circuits • Individual cut and bend lengths • Better time/rate analysis • Closer cost control • Invaluable labor saving • Immediate cost recovery.

Pays for itself in 2 weeks

"SPIN-PIN"®

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

- No Training
- No Pliers
- No Clippings
- Uniform Crimps
- 22 Sizes

PAYS FOR ITSELF THE FIRST DAY!

$5.00 EACH

Write for illustrated book to Dept. A-3P

BRUNO-NEW YORK INDUSTRIES CORP.
DESIGNERS & MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET • NEW YORK 1, N. Y.

Circle 676 on Page 17

plant in Los Angeles for manufacturing of materials handling equipment and systems. . . . **Singer Mfg. Co.** has arranged for the purchase of all the common stock of Haller, Raymond & Brown Inc., research and development firm, from Topp Industries Inc. The research firm will operate as a division of Singer and will maintain its corporate identity. . . . **Consolidated Controls Corp.** has contracted for office and plant facilities in Bethel, Conn.

MEETINGS AND EVENTS

March 10-11—

American Machine Tool Distributors Association. 34th Spring Meeting to be held at The Roosevelt, New Orleans, La. Additional information may be obtained from Al Bourgeois, Convention Manager, The Roosevelt, New Orleans, La.

March 11-14—

Pressed Metal Institute. Spring Technical Meeting to be held at the Sheraton-Cadillac Hotel, Detroit. Additional information is available from PMI headquarters, 3673 Lee Rd., Cleveland 20, Ohio.

March 17-18—

Steel Founders' Society of America. 56th Annual Meeting to be held at the Drake Hotel, Chicago. Additional information may be obtained from George K. Dreher, 606 Terminal Tower, Cleveland 13, Ohio.

March 17-21—

Fourth Nuclear Engineering and Science Conference. Sponsored and conducted by over 30 engineering and scientific societies under the coordination of Engineers Joint Council. Conference to be held at the International Amphitheatre, Chicago. Additional information is available from John A. Dever, Minneapolis-Honeywell Regulator Co., 707 W. Grange St., Philadelphia 20, Pa.

March 25-28—

Packaging Machinery Manufacturers Institute. Packaging Machinery & Materials Exposition of 1958 to be held at Convention Hall, Atlantic City. Additional information is available from PMMI headquarters, Suite 759, 1 Gateway Center, Pittsburgh 22, Pa.

March 26-28—

American Power Conference. 20th anniversary meeting to be held at Hotel Sherman, Chicago. Conference is sponsored by Illinois Institute of Technology in co-operation with 14 colleges and universities and 9 technical societies. Additional information is available from R. A. Budenholzer, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Ill.

April 14-16—

First Joint Conference on Automatic Control Techniques. Meeting is sponsored by AIEE, ASME, and IRE, and will be held at Hotel Statler, Detroit. Additional information is available from R. M. H. Berg, 330 West 42nd St., New York 36, N. Y.

April 14-17—

American Society of Mechanical Engineers. Annual Design Engineering Conference and Show to be held at the International Amphitheatre, Chicago. Further information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

April 14-18—

American Welding Society. Annual technical meeting to be held at Hotel Statler, St. Louis. Annual Welding Show to be held at Kiel Auditorium, St. Louis. Further information is available from Robert T. Kenworthy, 12 East 41st St., New York 17, N. Y.

REJECTS
LEE RAKER

AUTOMATION

Circle 677 on Page 17→

An improved
Combination Starter
for extra safety

While the changes in the new Allen-Bradley Bulletin 712 and Bulletin 713 starters may be relatively minor, they were made in your interest—to give you the best control on the market.

The new operating lever has been attractively restyled and structurally improved. Now the disconnect switch can be locked "open" or locked "closed"—with three padlocks of any kind. For the maintenance engineer, a concealed latch pin is built into the lever, which permits opening the door of the cabinet without opening the disconnect switch and stopping the motor. The door can also be padlocked shut independently of the operating lever.

With the disconnect lever in the "off" position, the cabinet door can be opened. At a glance, it can be seen that the movable contacts are open. An added "safety" feature—the incoming line connections are covered with an insulating plate to prevent accidental contact.

ALLEN-BRADLEY
QUALITY
MOTOR CONTROL

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

A-B
QUALITY
ON
OFF LOCK
OPEN
A-B

BULLETIN 712—These modern A-B combination starters cost no more than a separate starter and disconnect switch, and make a neater, safer, more attractive installation.

Size 1—to
7½ hp, 220 v;
10 hp, 440-550 v.

Size 2—to
15 hp, 220 v;
25 hp, 440-550 v.

Size 3—to
30 hp, 220 v;
50 hp, 440-550 v.

Size 4—to
50 hp, 220 v;
100 hp, 440-550 v.

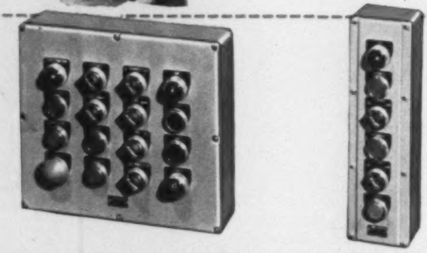
3-58-MR

Not only the Motor Starters, but the Accessories must be "Quality," too!

A-B
QUALITY

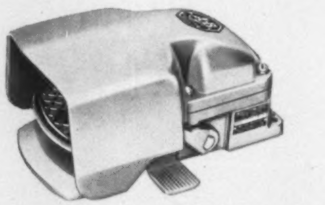
we specify ALLEN-BRADLEY ...all the way

"Trouble" that shows up in a motor starter is often traced to a faulty operating auxiliary—such as a limit switch or even a push button station. Allen-Bradley builds the same high quality into its many accessories as it does into its motor starters—to give you millions of trouble free operations. They are also tested as thoroughly. Contacts are usually double break and always are of a silver alloy, which means they remain in perfect operating condition. It will pay you, too, to specify Allen-Bradley *Quality* control—"all the way!"

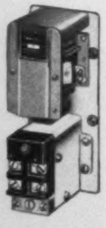


Bulletin 800T Oiltight Control Stations. Available in from one to sixteen units, in die cast aluminum enclosures.

Bulletin 802 Precision Limit Switch, with oiltight head and body.

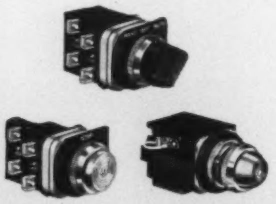


Bulletin 805 Foot Switch. In rugged die cast enclosure for the toughest service.



Bulletin 849 Pneumatic Timer. Reliable and accurate.

Bulletin 837 Temperature Control with snap action, precision switch.



Bulletin 800T Oiltight Push Button, Selector Switch, and Press-to-Test Pilot Light.

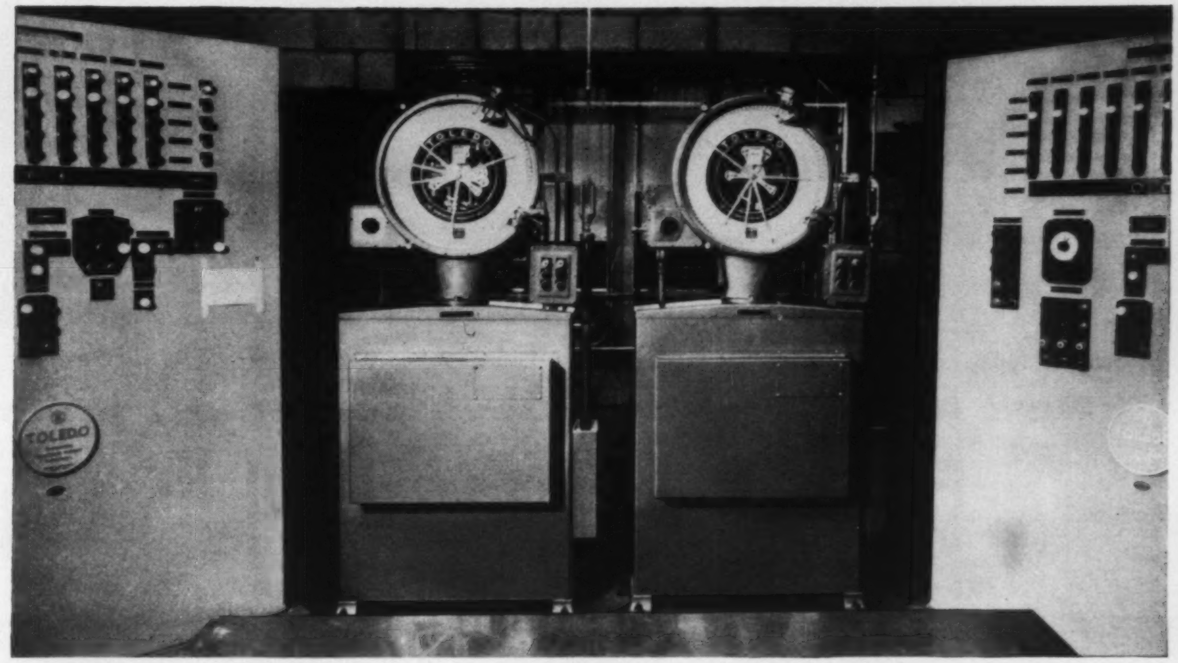
Bulletin 800 Standard Duty Push Button. One, two, and three buttons; also as selector switch.

Bulletin 836 Pressure Control in NEMA 4 watertight enclosure.

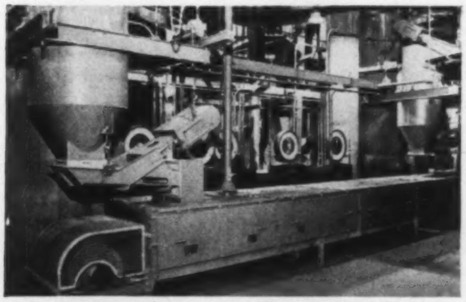
3-58-MR

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

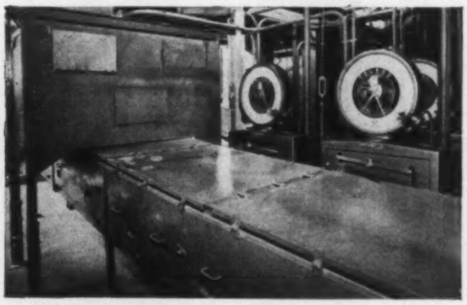
ALLEN-BRADLEY
QUALITY
MOTOR CONTROL



TOLEDOS control glass batching systems at Ford Motor Company's Nashville Plant



Two scale hoppers load conveyor with ingredients for plate glass. In background, a conveyor for sheet glass batch.



These Toledos are extra sensitive to weigh small quantities of ingredients such as carbon and iron oxide.

Automatic batching—using a Toledo system of weight control—helps the Ford Motor Company keep a watchful eye on quality and costs in production of glass at their Nashville plant.

All scales, hopper gates and feeder controls are interlocked and sequenced through the Toledo control panels shown in the photo above. Signal lights on the panels show progress of each batch cycle. The scale heads in the center provide a weight check for each complete batch before mixing.

On the floor above the control room, batch ingredients—soda ash, sand, carbon and iron oxide, for instance, are weighed and discharged onto conveyors by Toledo Hopper Scales. After mixing, another Toledo weighs out a preset amount of batch for the furnace. It's a continuous process calling for continuous control with speed and accuracy.

Let us help you find an efficient, cost-saving way to solve weighing problems in your plant. Write . . . TOLEDO SCALE, Division of Toledo Scale Corp., Toledo 13, Ohio.

TOLEDO®

HEADQUARTERS FOR WEIGHING SYSTEMS

SERVICE
Factory-Trained
200 Cities

FLOOR AND TRUCK SCALES

BENCH AND PORTABLE SCALES

OVER-UNDER SCALES

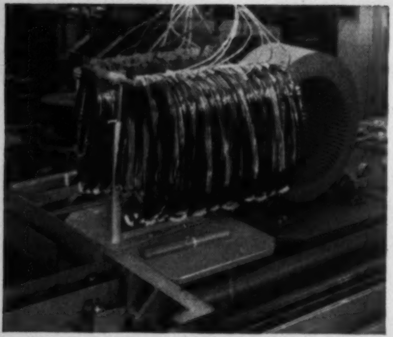
WEIGHT PRINTING

OVERHEAD TRACK SCALES

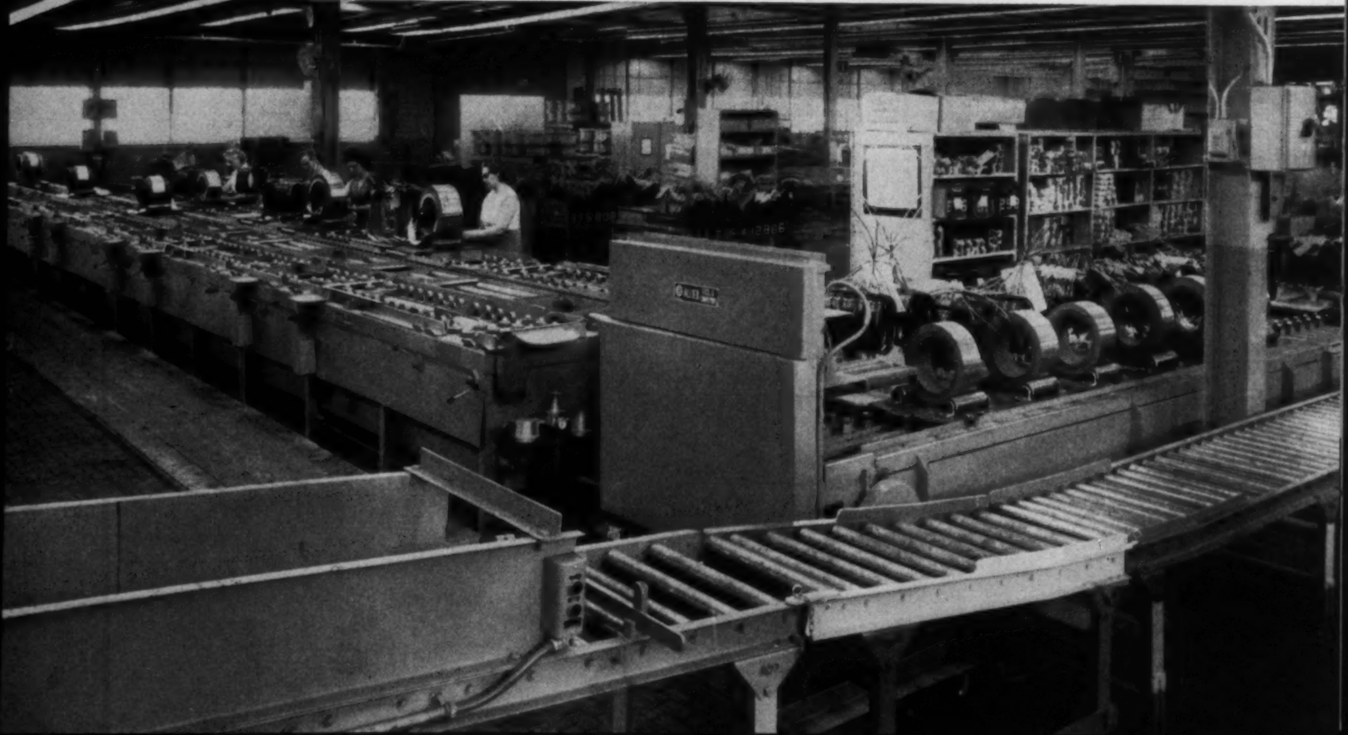
COUNTING SCALES

New Allied Conveyor Developments Combine

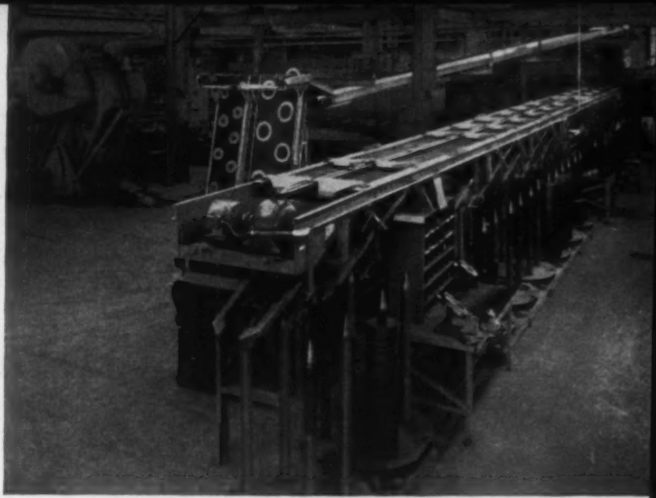
Custom Manufacturing Flexibility with



WORK DELIVERED AUTOMATICALLY TO FIRST AVAILABLE OPERATOR: In the inserting and connecting area, Allied's unique equipment quickly matches and automatically feeds coils and stator cores to the first available operator. No physical handling is required. Coils and stator cores are transferred from conveyor line to work station by power driven rolls (insert at left). These rolls are actuated by a stop which automatically indicates an empty station. When work is completed, wound stators are automatically transferred to the next station.



CONTINUOUS PARTS FLOW BETWEEN SEPARATE MACHINING AND ASSEMBLY BUILDINGS—Component parts machining operations for small General Electric motors are completed in a separate building from the assembly area. Parts delivery is made by this trestle and overhead conveyor which provides clean components ready for immediate assembly.



AUTOMATIC SORTING, DELIVERY, AND STORAGE: Approximately 125 different types of rotor and stator punchings are taken from the punch presses and are automatically sorted, delivered, and placed on specially designed storage spindles. Under floor conveyors deliver to vertical magnetic belts.

Production-Line Speed

When General Electric's Small AC Motor and Generator Department planned their new facilities for Tri-Clad* '55' motors in the 40 through 125-horsepower range, they established three objectives: improved motor quality, reduced manufacturing cycles, and better customer service.

Allied design engineers tackled the job of providing straight line production facilities with built-in flexibility for manufacturing special as well as standard motors. The solution proved so satisfactory that the time required to produce special motors on order was cut in half—or less time than was formerly required to build a standard motor. The installation included structural steel, many types of conventional conveyors, a variety of cranes and automation equipment.

Write for free booklet on Automatic Handling by Allied.

*Reg. trade-mark of General Electric Company. 57-2

TESTING ON THE MOVE: A uniquely designed shuttle in the test equipment area allows testing for vibration and overload without stopping the conveyor line. Conditions are automatically controlled to eliminate human error.

VARIETY OF COMPONENTS READY FOR ASSEMBLY: Varieties of standard components are maintained in areas like this so that they are immediately available for assembly, either to stock order or to special customer order.

ALLIED CONVEYORS

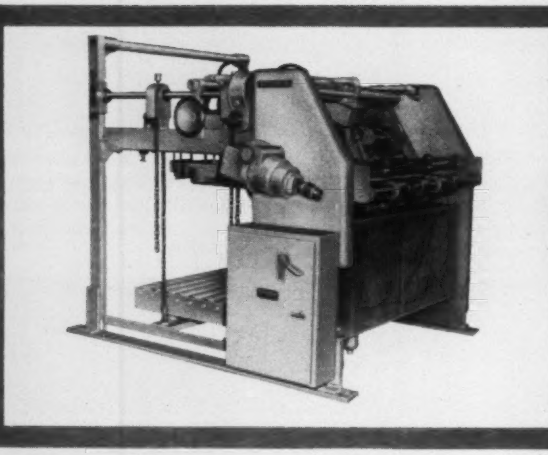
ALLIED STEEL & CONVEYORS, DIVISION OF SPARTON CORPORATION
17361 HEALY AVENUE, DETROIT 12, MICHIGAN, CABLE ADDRESS: ALCON

Offices in all principal cities. Complete conveyor systems including: Trans-Free, Chip, overhead, elevators, shuttle bars, floor, pan, flat-top, forging feeders. Automatic handling equipment: automatic tire mounters, pig stackers, turnovers, turntables; and other special engineered materials handling equipment.

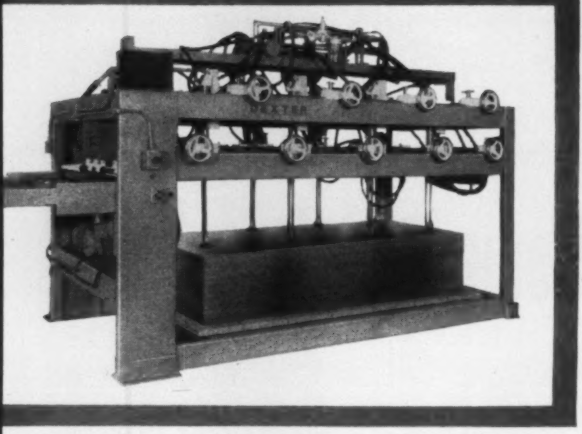
Circle 679 on Page 17

NEED HELP WITH

Sheet Handling Problems?



Dexter 9000# H.D. Feeder runs at speeds up to 9000 sheets of tin plate per hour. Used primarily in most major metal decorating plants.



Dexter Plate Feeder handles metal plates up to 3/16" thick and a maximum size of 4-by-12 feet. Used in many plants for feeding descaling equipment.

CHECK WITH DEXTER

Dexter's been designing and building sheet handling equipment for over 75 years...*sheet feeders* for metal decorating presses, scroll shears, punch presses, coaters, slitters...*pack turnovers* for speeding up two operation processes...*oven strippers* and *pilers*...*cardboard* and *corrugated board feeders* for presses and packaging lines ...*paper feeders* for printing presses, varnishers and folding machines. For almost any sheet feeding problem Dexter has the answer... with its wide range of equipment.

Dexter Feeders are available in over a hundred sizes, speeds and load capacities to suit individual machine or process requirements. Sheet sizes range from 14 x 14" to four by twelve feet...sheet thickness from .006" to 3/16" or more...load capacities from 6,000 to 30,000 pounds ...and speeds from 600 to 9000 per hour!

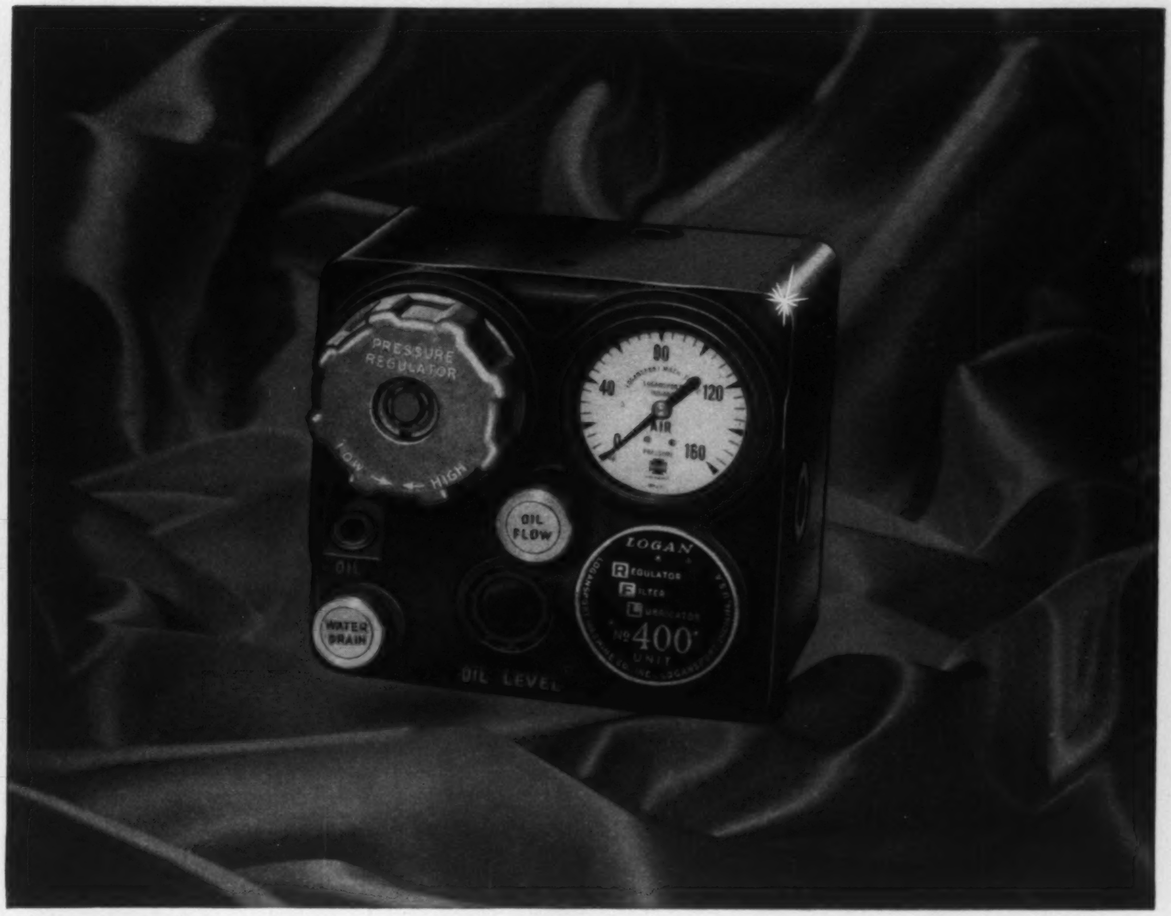
Thousands of Dexter sheet handling machines are in use today in container plants, electrical equipment factories, appliance manufacturing plants, in tin plating lines, printing and binding companies, and in a wide variety of other industries...speeding up production efficiently and economically.

If you need help with your sheet feeding problems—check with Dexter. Their combination of engineering experience and equipment flexibility may be the solution for increasing your productivity.

Write or call for complete details.

DEXTER
FOLDER COMPANY
DIVISION OF MIEHLE-GOSS-DEXTER, INC.

General Offices: 219 East 44th Street, New York 17, New York


PRESSURE REGULATOR
LOW
HIGH
40
80
120
160
0
AIR
OIL FLOW
OIL
WATER DRAIN
OIL LEVEL
LOGAN
Regulator
Filter
Lubricator
No 400
UNIT

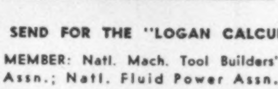
Illustrated—Logan Model 400 RFL Unit

Look to Logan

the ultimate in air circuit accessories

Logan RFL Unit, the designers choice for over a decade! Protects your air-powered equipment . . . regulates pressure . . . filters air . . . lubricates air. Adds years of dependable performance.

New Model 400, illustrated above, is a companion model to the well-known Model 600.


LOGAN
LOGANSPORT MACHINE CO. INC.
LOGANSPORT, INDIANA

FREE SEND FOR THE "LOGAN CALCULATOR"

MEMBER: Natl. Mach. Tool Builders' Assn.; Natl. Fluid Power Assn.

LOGANSPORT MACHINE CO., INC.
848 CENTER AVENUE, LOGANSPORT, INDIANA

PLEASE SEND COPY OF CATALOG:

☐ 100-1 AIR CYLINDERS
☐ 100-2 MILL-TYPE AIR CYLS.
☐ 100-3 AIR-DRAULIC CYLS.
☐ 100-4 AIR VALVES
☐ 100-5 LOGANSQUARE CYLINDERS
☐ 100-6 ULTRAMATION CYLINDERS
☐ 300-2 PRESSES
☐ FACTS OF LIFE
☐ 200-1 HYD. POWER UNITS
☐ 200-2 ROTOCAST HYD. CYLINDERS
☐ 200-3 750 SERIES HYD. CYLINDERS
☐ 200-4 AND 200-7 HYD. VALVES
☐ 200-6 SUPER-MATIC CYLS.
☐ 300-1 CHUCKS
☐ ABC BOOKLET
☐ CIRCUIT RIDER

TO:

NAME________________ TITLE__________

COMPANY ____________________

ADDRESS ____________________

____

Circle 681 on Page 17

Tom's
Fresh!
CORN-CHEEZ
WHEATIES
GOOBERS
KRAFT
miniature
marshmallow
FREE SAMPLE
RAISINETS
chunky
CUTIE
Cheerios
SCHRAFFT'S
PERM-O-SEAL

THEY'RE ALL ROBO-WRAPPED! Blumenthal Raisinettes and Goobers, Federal Plastic Tableware, Perm-O-Seal, Schrafft's Gums and Jellies, Chunky Chocolate Squares, Tom's Corn Cheez, General Mills Wheaties and Cheerios, Kraft Miniature Marshmallows sample package.

FORM, FILL, SEAL AUTOMATICALLY
PILLOW-PACKAGING CUTS COSTS

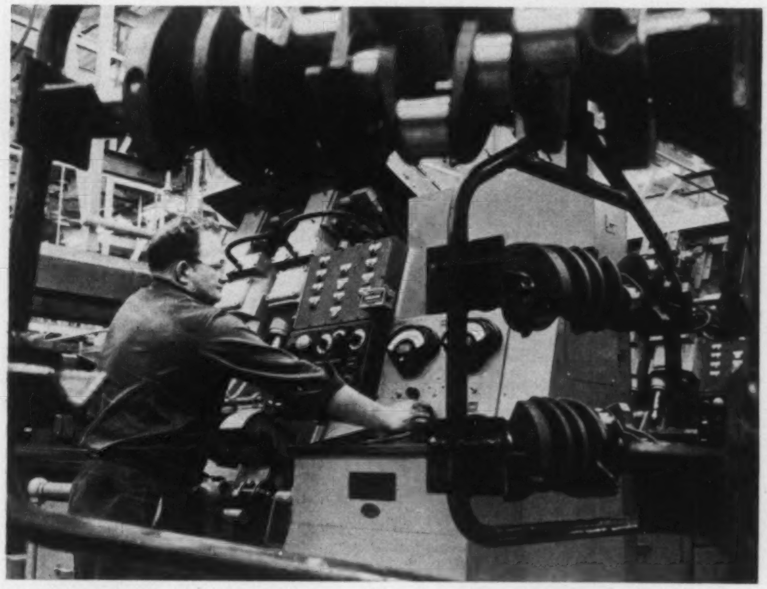
Does your product belong in this picture? It does if automatic packaging can save you money. Doesn't matter whether you package solids, powders, granules or liquids . . . Robo-Wrap heat seals them in a single or double wall of cellophane, paper, polyethylene, Foil Laminates, Mylar or Saran. Hand-over-hand method forms, fills and seals packages from a continuous roll for highest efficiency. Robo-Wrap changes package size quickly, too. Write for booklet that gives facts on low maintenance and higher efficiency.

LYNCH ROBO
CORPORATION
A Subsidiary of
LYNCH CORPORATION
Anderson, Indiana

Meet us at PM and ME show, Atlantic City, March 24-26, Booth 401

detroit dateline

By **JAMES C. KEEBLER**
Managing Editor



Semiautomatic electronic machine accurately balances V-8 engine crankshafts at Ford Motor Co.'s Cleveland Engine Plant No. 2. Machine determines amount and location of unbalance and automatically drills holes in counterweights to remove unbalance. This Olsen machine is equipped with safety interlocks to prevent damage to either the crankshaft, machine, or operator in the event of malfunctioning of any part.

Foolproof Automation

WEBSTER'S says that *foolproof* means, "So simple, plain, strong, or the like, as not to be liable to be misunderstood, damaged, etc., even by a fool."

This makes foolproof automation a big challenge. Right off, the toe is stubbed on the word *simple*. By the very nature of the problem most automation installations are not simple. Yet there is a great demand to make them foolproof.

Fearful Angels

The chance of being misunderstood is one of the stumbling blocks on the main road to automation in general, but the misunderstanding that goes with the requirement that a machine be foolproof in its operation can develop into some lasting hatreds.

Pope had the key idea when he observed that fools rush in where angels fear to tread. These hasty fools have been fouling up production since the invention of the round wheel. Machine and tool designers must compromise cost and workability with ingenious devices that prevent mishaps.

Originally the villain of a fool was a scheming stumblebum that loaded a whole run of parts upside down in a jig. This led to the invention of the "foolproof pin." But the complexities of design and the craftiness of the fool combined to spell disaster. There is still no known design of foolproof pin that is not removable.

Tale of Woe

The designer's problem is not only to be able to devise an arrangement that will work, but also to anticipate the troubles that may occur.

One tool designer, who was on the carpet because his milling fixture design was not foolproof (a right-handed, five-thumbed apprentice had pinched his left index finger in the clamp latch), pleaded his plight with this anecdote:

I'm like the father who made a list of all the evil pranks his youthful sons had pulled, added a few of his own boyhood achievements, and finished it off with all the troubles he could foresee. Then he got his obstreperous offspring to agree not to commit any of the listed offenses. Upon return from a long hard day at the mill he found his house in shambles. Young American ingenuity had thought up something that wasn't on the list.

Accentuate the . . . .

This predicament underscores the feeling that it is easy to be wise after the event.

This may also point out why the process engineering departments in Detroit are split about 50-50 between graduate engineers and shop-trained men. Classically, engineering schools (and formal education in general) accentuate the positive. Do this and expect this result. These things work like so. The student is taught what is so—it's a waste of time to learn what's *not* so.

But most old-timer master mechanics will tell you that the shop man's school of knocks and bumps accentuates the negative. He remembers the failures, the bonehead designs, the tries that went astray. For every proposed improvement, he can recall six good reasons why it won't work, or why, "It wasn't worth a damn the last time we tried it."

So far as making things foolproof is concerned, the old-timer has learned a lot from the fools. Just as Cato the Censor observed that wise men learn more from fools than fools from the wise, so there is no substitute for practical experience when it comes to learning what can go wrong with a seemingly good design.

Automated Age

In the age of automation the machine has fewer skirmishes with the fool than was formerly the case. Automatic loading, clamping, machining, gaging, and unloading keep the hands outside the danger zone and more workers are thus able to keep their hands. The modern transfer machine for engine blocks is enclosed by fence-wire guards and the sign on the push-button panel says, "Do Not Operate Without Guards."

Complete salvation cannot be claimed. Reports from one auto factory tell of a pair of workers who were discussing the late show. The tired-hand that had stayed up for the late-late show leaned on the ways of a transfer unit to give him support while commenting on the chase, and before the posse got through the gulch the main slide came back and smashed his hand.

Such events are seldom written-up in technical journals. As a matter of fact few failures in design ever reach print. This accentuation of the positive might be good public relations, but the failure to record failures seems to ignore the fact that there's a lot to be learned studying mistakes. In this regard safety engineers have long been valiantly trying to protect workers from recurrence of accidents. It's an unwritten law that no man should fall twice through the same uncovered manhole.

Safe Failure

Lessening the chance of human injury by use of automatic devices tends to ease the foolproofing requirements placed on the designer, but the gain is offset by the complexity of the equipment and the need to make it foolproof with respect to damaging itself and/or its workpieces.

This opens up a line of reasoning that asks what can go wrong and what happens when it does. In case of power failure in the midst of a cycle—what happens when the power goes off? — what happens when it comes back on again? If a failure occurs in the compressed air system does the machine destroy itself?

Not only must failure of services to a machine be considered, but failure of components within the machine must be analyzed on the basis of what disastrous results might occur. This is a game of chance and the designer becomes a gambler that must consider both the odds and the stakes.

Control circuit design is probably affected more by this problem than any other phase of equipment design. Limit switch failure, solenoid sticking, burned-out contacts, and stuck valves are but a few of the hazards. If all components are working properly and the circuit is designed to do the job, the desired action will result. But unpredictable performance on the part of any one component can make it play the role of the fool, and unexpected action of the equipment can mean disaster.

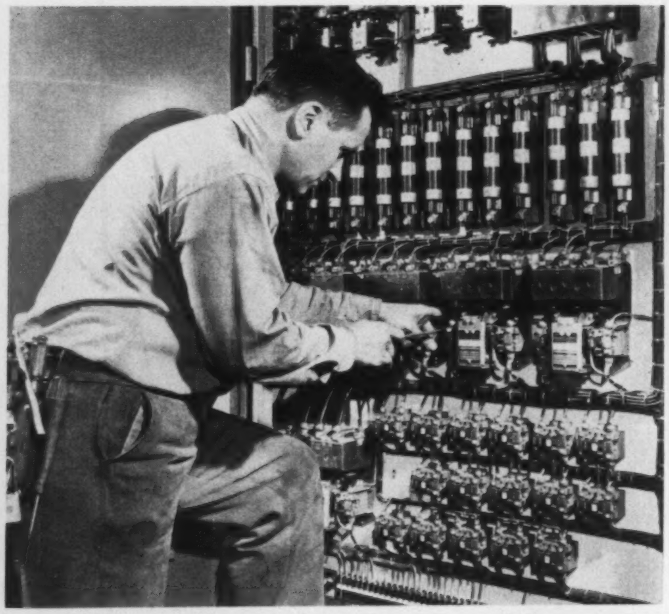
Chrysler uses a system on drawings of control panel circuits that requires a signature in a box marked "Fail Safe Checked." This serves as a reminder that the system must not only be designed to "work" properly but also to "not work" properly. The question of how far to go in making such checks of a system design is all part of the gamble.

Security at a Price

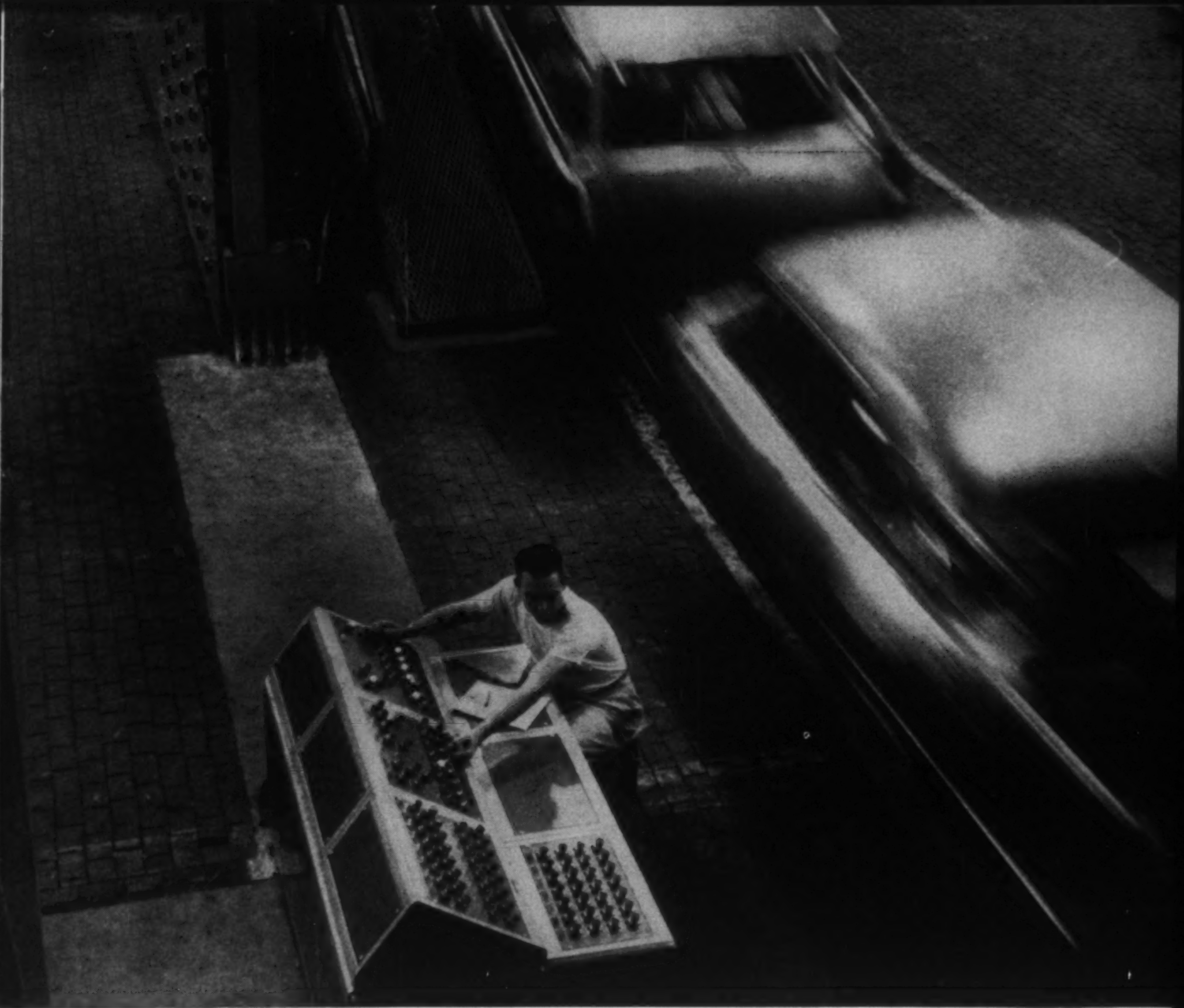
Much has been learned about the art and science of foolproofing. A lot of this knowledge has resulted in the use of additional safety interlocks, double-hit controls, motor-load meters and similar protective devices that do not play a productive role in the function of automated equipment, but prevent destruction when something is not working properly.

Even the warning light has been redesigned so that it will light when pressed. This press test verifies that the bulb is not burned out and provides assurance that it will light if trouble occurs.

Eternal vigilance is still the price of security. Even though experience has given automaters wisdom to make equipment more foolproof it is well to understand that the unexpected happens every day and that absolute foolproofing is akin to 100 per cent perfection.



Electrician makes adjustments to one of Ford's complex electrical control panels. Design of control circuits for production machinery must include considerations that make machine operation foolproof.



The **FORWARD** Look develops...

AUTOMATIC CAR-A-MINUTE ASSEMBLY WITH WESTINGHOUSE DRIVES AND CONTROL

This man helps direct a 1960-new control system engineered by Chrysler Corporation and Westinghouse for unique material-handling methods. Utilizing more electrical power and exacting control, Westinghouse designed this system to automatically synchronize the flow and positioning of parts for assembly along 51 conveyor lines. Here is a system, too, that minimizes unscheduled plant down time and many maintenance headaches.

On the next five pages you'll see how Chrysler is perfecting "tomorrow's" assembly . . . today. Here are head-start ideas you can use, if you begin now to POWER-UP electrically. MP-3058

YOU CAN BE SURE...IF IT'S Westinghouse

Circle 683 on Page 17

How do ivory fenders reach the ivory body shell on time and in position?

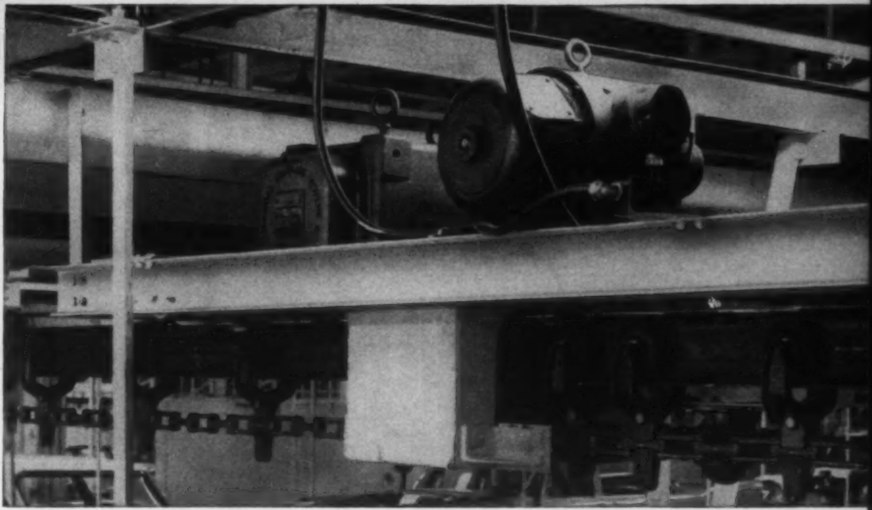
MAGAMP-CONTROLLED AV DRIVES INSURE EXACT MATCH-UP OF BODY PARTS

In this Plymouth assembly plant, two and one-half miles of floor conveyor and over five miles of monorail conveyor are synchronized to travel in unison. Transfer from one conveyor to another is completely automatic at hundreds of transfer points. For example, front fenders (above) travel to the right and left side of the body assembly conveyor, arriving at the assembly point exactly in step with a body shell of the same color.

Circle 683 on Page 17

▲*Fully automatic, Magamp speed and position control can be operated manually if desired. Magamp is most ideally suited to automatic operation as it is a highly reliable static device requiring no maintenance and no warm-up time.*

▼*Conveyor AV Drive components are factory-assembled in free-standing cabinets centrally located in each plant zone.*



Westinghouse Life-Line® Motors ▶ *are located on conveyor supports or below the floor for conveyor drives. Prelubricated bearings and rugged insulation protection require minimum maintenance.*

Westinghouse AV Drives provide the complete, adjustable voltage d-c drive and regulator system to power up and synchronize all conveyors. A synchro-tie transmitter on the lead conveyor, or an independently driven transmitter, is used as a master reference for all slave conveyor sections. The transmitter on each slave conveyor is used to signal exact conveyor position. A Magamp* regulator compares the master and slave synchro-tie signal and makes any necessary correction to hold each slave conveyor in step with the master. Exact control of the line speed is possible by means of incremental speed adjustment of the master synchro-tie transmitter. On multi-motor conveyor section drives, correct load sharing between motors is insured by proper machine and control coordination.

*Trade-Mark

Next page—Static control memory helps schedule assembly.

YOU CAN BE SURE...IF IT'S Westinghouse

Circle 683 on Page 17

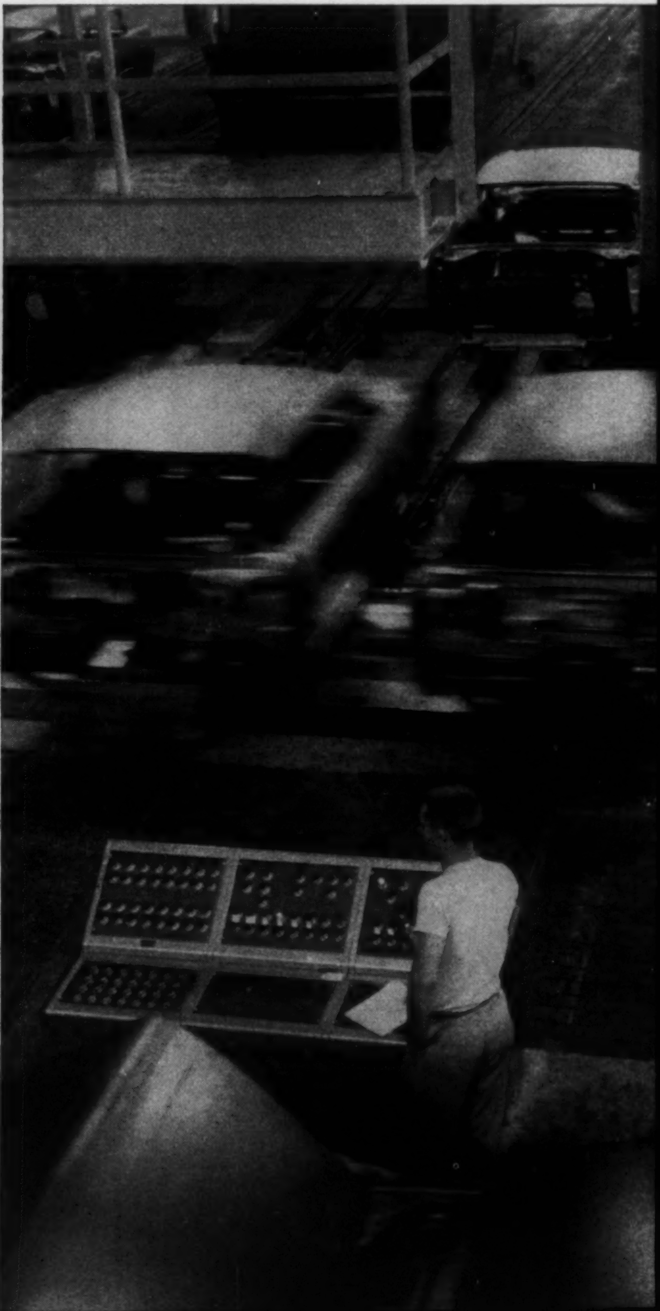
How is each body shell picked out of hundreds and prescheduled for color styling?

CYPAK CONTROLS PUSHBUTTON SORTING, STORING AND TRANSFERRING

Modern assembly means no manual handling at the Plymouth plant in Newark, Delaware. Example—Cypak* control systems provide pushbutton handling for each body shell as it is stored and transferred through this 15-conveyor-line

---

*Trade-Mark



Circle 683 on Page 17

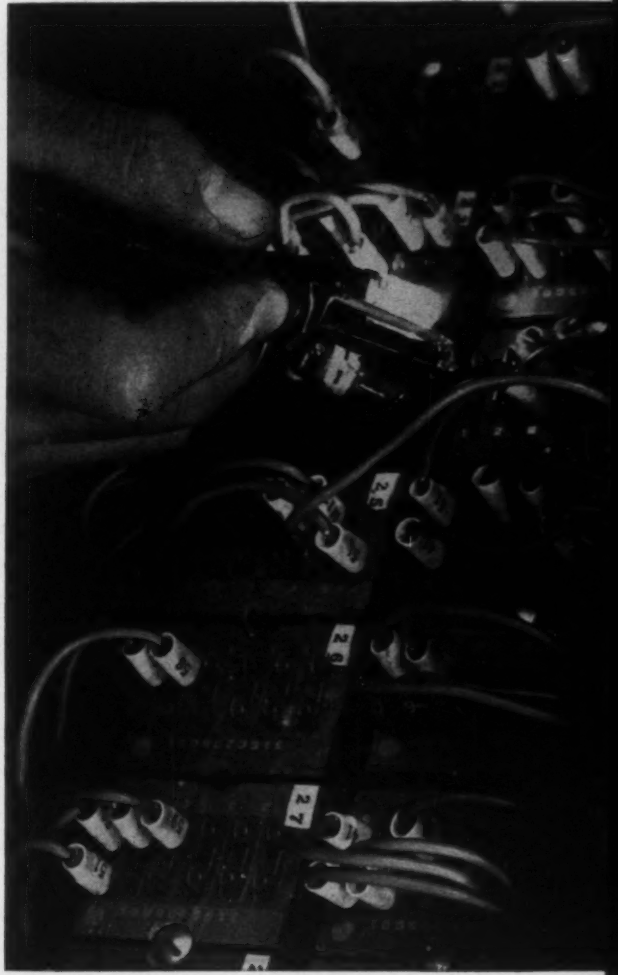
storage bank. Cypak takes full responsibility for storage and for removing each auto body in preselected order to meet paint shop scheduling.

The operator at the console (below left) selects a storage line for each auto body by pressing a pushbutton. This initiates an indexing cycle which automatically follows through at all transfer points. At the other end of the storage line (below center) an operator selects the proper production mix of body style. Cypak automatically indexes the body shells through each transfer point to the main conveyor.

Cypak static control was selected for this memory storage system because it is completely maintenance-free. System reliability is extremely high.

Next page—Control planning simplifies trouble shooting.

YOU CAN BE SURE...IF IT'S Westinghouse

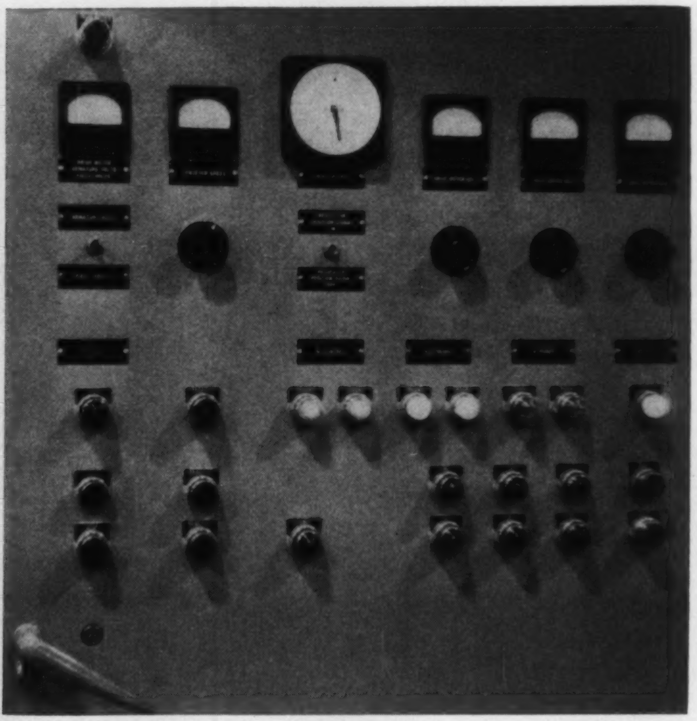


Cypak control elements are plugged into power channel busway to form compact system assembly for easy inspection. Wiring system diagram designates proper connections for tab connectors between top terminals.

Circle 683 on Page 17

How does electrical planning limit down time?

COORDINATED CONTROL AUTOMATICALLY TAKES RESPONSIBILITY



. . . to simplify trouble shooting

Unscheduled down time is minimized because of careful planning between Chrysler and Westinghouse engineers. Trouble locations are pinpointed by signals on panel-front diagrams (above left) of conveyor lines. A panel-front synchroscope (above right) is located on each AV Drive cabinet to keep electricians accurately informed of conveyor synchronization.

Checks on the position-regulating system are made automatically. If a position error above tolerance occurs, the conveyor will stop and postpone transfer until it is safe.

. . . during shutdown and start-up

Cascade-type electrical interlocking prevents pile-ups wherever a series of conveyors are running together. Any stop on one conveyor will stop all conveyors feeding into it. After the first conveyor is restarted, the others will automatically restart. The responsibility for starting and stopping conveyors is built in through advanced electrical planning.

If your production plans call for forward-looking material-handling drives and control, call your local Westinghouse sales engineer for expert counsel and experience, or write Westinghouse Electric Corporation, 3 Gateway Center, Box 868, Pittsburgh 30, Pennsylvania.

YOU CAN BE SURE...IF IT'S
Westinghouse

Circle 683 on Page 17

AUTOMATION problem forum

Readers with problems concerning systems, equipment or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Solution suggestions should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

Case 1415-P
Circuit Board Machines

. . . We are in the process of expanding and improving our etched circuit board facilities. In order to wisely select equipment of this nature we would like to avail ourselves of as many sources for this equipment as is practical considering the relatively short lead time available to us.

The type of equipment we seek is generally outlined as follows: 1. Machine to clean surfaces of copper clad circuit board materials suitable for further photoetch processing and roll solder tinning. 2. Machine to dip solder circuit board assemblies (automatic or semiautomatic). 3. Machine to clean process contaminants from circuit board assemblies after dip soldering. 4. Machine or device to dry moisture from circuit board materials and circuit board assemblies. 5. Machine to roll solder tin-coat circuit board materials prior to dip soldering. 6. Machine to apply liquid flux to circuit board copper surfaces prior to roll soldering or dip soldering.

We would appreciate having the names of as many firms known to you who manufacture such equipment . . .

Supervisor, Manufacturing Development

Suggestions for 1316-P (Oct. 1957)
Garment Packing

. . . We are interested to know the details of the case. It may well be that these people can use our experience, knowledge, and ingenuity to the mutual advantage of our companies . . .

J. R. Stoddard
Barkley & Dexter Inc.

◆

. . . We believe we can be of service. We are a design firm, but are equipped to also build and erect any machinery we may design . . .

John Mihaila
Helmick Design Service Inc.

◆

. . . We would appreciate information concerning this case. We feel that we might be of some service to these people . . .

E. Ralph Sims Jr.
Alden E. Stilson & Associates

Suggestions for 1275-P (Oct. 1957)
Rotary Switch

. . . We have at the present time switches adaptable to rotary actuation capable of accurate operation at speeds in excess of 2000 cycles per minute. These switches have a mechanical life expectancy at this rate of actuation in excess of 50 million cycles . . .

Jack Kogel
McGill Mfg. Co. Inc.

◆

. . . We would appreciate the opportunity of working with this engineer. We have a lot of experience in designing and building special rotary limit switches . . .

Gordon Cork
Gemco Electric Co.

◆ ◆ ◆

Suggestions for 1277-P (Oct. 1957)
Powder Moisture Control

. . . We have for years manufactured instruments which will solve this problem. These instruments are sold exclusively by Hart Moisture Meters Inc. . .

M. Bjorndal
Tech Laboratories Inc.

◆

. . . Our d/M-Gauge described in the enclosed brochure might be just the instrument for this job. The main limitation of the nuclear method of determining moisture content is that the material contain no large amounts of bound hydrogen. The unit is suitable for measuring moisture content from 0 to 100 per cent.

J. P. Aldworth
Nuclear-Chicago Corp.

◆

. . . We believe our SCI 400 control unit will do the job required if the volume of the flow is of a constant nature . . .

George W. Laub
Security Controls Inc.

◆

. . . The equipment this gentleman is looking for is the Dietert Moisture Controller, as sold to the foundry industry . . .

L. Boorman
Canadian General Electric Co. Ltd.

Post Decitron electronic products

Model SD-1T

This *new* Post electronic counter outmodes all mechanical counters. Capable of operating at speeds up to 100 units per second, a single "count" is indicated on the six digit totalizer as each *tenth* item breaks the light beam. For counting dozens or gross a 12 place counting tube can be substituted. May be operated from microswitch, photohead or Post magnetic switch.

Standard SD-1T **$140.00**

Model SD-1

Same as above, without totalizer. Boosts service life of mechanical registers 15 times by counting in units of 10. Can be placed several hundred feet from switch contacts.

SD-1 .... **$98.00**
With Remote Totalizer **$125.00**

Model MH-2

Magnetic Switch . . . high speed — ideally suited to sensing applications — will actuate electronic counters, mechanical counters, controls, solenoids, relays and many other circuits. Capable of speeds up to 100 cycles per second. Long service life.

Feature . . . sharp, clean make or break — no lag, no bounce.

Thousands in use **$29.75**

POST ELECTRONICS
Division of Post Machinery Co.
159 Elliott St., Beverly, Mass.

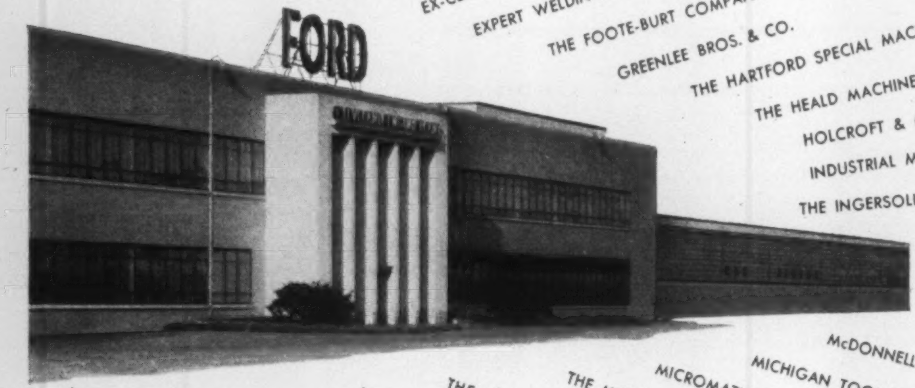
Decitron
POST ELECTRONICS
Division of Post Machinery Co.
159 Elliott St., Beverly, Mass.

☐ Send literature on Model________
☐ Please send name of nearest representative

Name________________
Company________________
Address________________
City________________State________

Circle 684 on Page 17

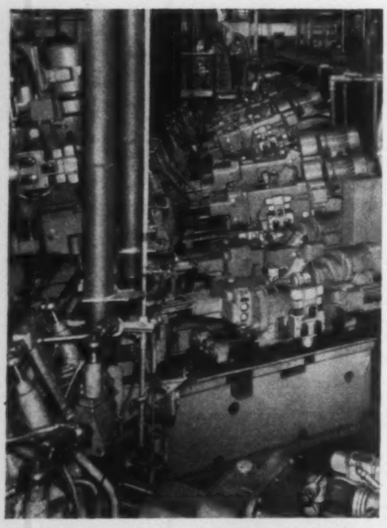
At The Ford Motor Company's Cleveland Engine Plant No. 1



AMERICAN BROACH & MACHINE DIVISION
BARNES DRILL COMPANY
BUHR MACHINE TOOL COMPANY
THE CROSS COMPANY
EX-CELL-O CORPORATION
EXPERT WELDING MACHINE CO.
THE FOOTE-BURT COMPANY
GREENLEE BROS. & CO.
THE HARTFORD SPECIAL MACHINERY CO.
THE HEALD MACHINE COMPANY
HOLCROFT & COMPANY
INDUSTRIAL METAL PRODUCTS CORPORATION
THE INGERSOLL MILLING MACHINE COMPANY
THE LAPOINTE MACHINE TOOL COMPANY
LANDIS TOOL COMPANY
THE R. K. LE BLOND MACHINE TOOL CO.
McDONNELL MACHINE TOOL, INC.
MICHIGAN TOOL COMPANY
MICROMATIC HONE CORPORATION
THE MORRIS MACHINE TOOL CO.
THE MOTCH & MERRYWEATHER MACHINERY CO.
NATIONAL AUTOMATIC TOOL CO.
SNYDER TOOL & ENGINEERING CO.
SUNDSTRAND MACHINE TOOL CO.
WICKES MACHINE TOOL DIVISION
WILSON AUTOMATION COMPANY

VICKERS® HYDRAULICS

HELPS CUT MAINTENANCE COSTS of Machinery Supplied by These Companies to This Modern Automated Plant



Typical transfer line installation shows ample use of Vickers hydraulics for actuation and control of automated operations.

High production is convincing proof of equipment reliability—one of many reasons why Vickers Hydraulics is engineered into equipment for modern automated production plants.

The above manufacturers find that Vickers Hydraulics simplifies installation and minimizes piping—benefits also enjoyed by the user. Vickers highly efficient pumps produce significant power savings . . . Vickers controls help minimize scrap and rework by providing precise positioning for machining and other in-process operations. Component dependability helps provide extended periods of uninterrupted production. Demountable unit construction simplifies on-the-job repairs and helps reduce downtime.

The Vickers complete line of components is ideally suited to hydraulic equipment standardization and interchangeability, reducing replacement inventory. Our application engineers will supply detailed information without obligation. General Catalog 5001B is available upon request.

7996

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1536 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO CINCINNATI • CLEVELAND • DETROIT • GRAND RAPIDS • HOUSTON • LOS ANGELES AREA (El Segundo) MINNEAPOLIS • NEW YORK AREA (Springfield, N.J.) PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER • ROCKFORD SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS TULSA • WORCESTER • Factories also in: AUSTRALIA ENGLAND, JAPAN AND GERMANY • In Canada: Vickers-Sperry of Canada, Ltd., Toronto, Montreal and Vancouver

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Circle 685 on Page 17

AUTOMATION

MARCH 1958

The Right Perspective

Experience of recent years has demonstrated that small-lot and diversified production operations can be automated to a significant degree. Savings in overall costs can range from modest gains to phenomenal reductions as high as 80 per cent.

There are two main approaches to small-lot automation. One is that of programming basic machine operations by means of punched card or tape control. Uses on machine tools range from simple table positioning all the way to complete programming including automatic selection and insertion of tools. The scope of development is indicated forcefully by the fact that hundreds of concerns are known to be developing such equipment.

With punched card or tape control, both setup time and run time are reduced significantly. Tape controlled lines, for instance, can be developed to produce a wide range of basically similar parts in small lots. On the other hand, parts such as jet engine casings can have hundreds of holes in the periphery bored by means of card control with exacting repeat accuracy in a fraction of the time ordinarily required. Cement, cattle feed, and other processing plants can be programmed for any lot size with prepunched cards.

The relevant factor involved here is not the product or number of units produced but the total number of like operations performed. Since volume is needed for economic justification of equipment cost, volume must be created by one means or another. Volume of operations performed is the answer and good planning of the product can help through use of modular design or standardization of characteristics.

The second approach is that of ingenious use of basic large-lot automation techniques. Typical of such applications is the use of transfer machines on which short runs are economical. Proper evolution of product design and production equipment in such cases saves capital investment, labor, setup time, and run time.

Another important phase of this second approach concerns the use of basic handling devices to reduce in-process costs. Feeders for assembly lines, conveyor handling of stock in process, hopper and conveyor feeding of purchased parts to the lines, overhead conveyor storage of parts with power or gravity feed, and many additional handling ideas can be used. Valuable floor space is conserved and increased output can be obtained through integration of production operations with considerably less investment in buildings.

With the right perspective the opportunities are many. The key to success is in the imagination, ingenuity and inventiveness of the management and automation engineering functions.

EDITOR

Special Report

AUTOMATION FOR SYSTEMS APPROACH

In January, 1954, an Automation Task Force was established to coordinate and press forward the development of automation and mechanization within the Light Military Electronic Equipment Dept., Defense Electronics Div., General Electric Co. The business of this Department involves the low-quantity production of a wide diversity of highly complex electronic equipments. The Automation Task Force members, four of whom prepared material in this presentation, work together as a team, spending full time on the assignment. The charter assignments of the Task Force are to formulate a basic approach to the problems of automation and mechanization under the circumstances that prevail in the Department's business, to perform operations analyses that establish the facts in each case taken up, to issue progress reports, to recommend automation projects to management, to foster integration among the various functional elements of the Department, and to keep abreast of new developments in automation and mechanization technology. The process of establishing, developing, and applying the principles of automation has been termed "automatology." The presentation which follows records techniques and concepts which have been developed.

By **ARTHUR F. MAYNARD**, Chairman, Automation Task Force, General Electric Co., Utica, N. Y.

OUR TASK FORCE has operated on the basis of the systems approach, which is stated as the formulation of the needs of each part of the system from an understanding of the whole system. Of necessity, the province of the Task Force cuts across all boundaries and touches all functions of the Light Military Electronic Equipment Department. From the beginning, it has been assumed that the restriction of an automation program to a single area, such as manufacturing, would artificially restrict the benefits of automation and would not give a well formed picture of our whole operation. This assumption was just a matter of intuition at the outset; but the experience of three years has shown that it was correct.

Our approach to the problem has been boiled down to four cardinal points: Collecting information and facts; analyzing and classifying this data; drawing conclusions and establishing concrete goals; and implementing the program, that is, applying the results of our studies and analyses.

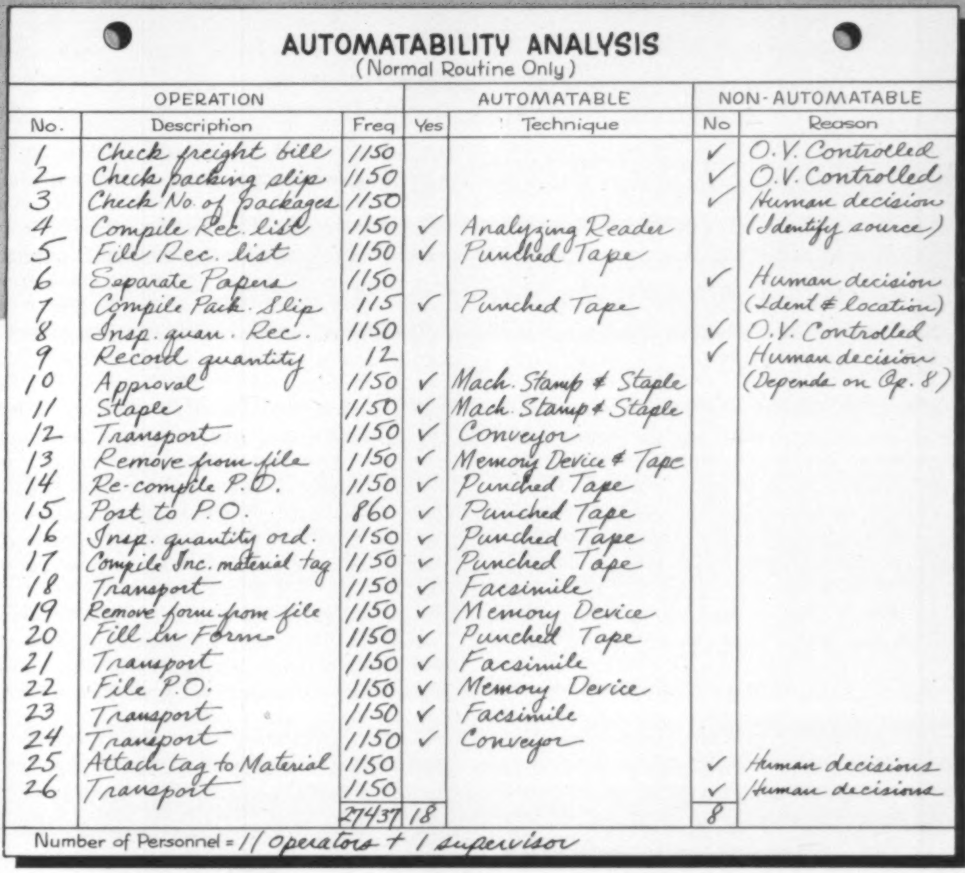
The first things done were to learn the bench marks and boundary lines of the light military electronic equipment business, to understand how the Department operated (especially the relationships between functional units), to develop formulas for calculating the probability of success in applying automation, to get a broad estimate of the worth of this effort, and to define a long-range program.

During this first stage, six projects were undertaken: The Department's current and anticipated production contracts were analyzed. Flow charts of all routines in use within the Department were made, to which were added use-frequency and applied manpower figures. Summary charts were then prepared for each major section, such as manufacturing. An Equivalent Manpower Analysis was made by examining and comparing all jobs in the Department. A Components Parts Analysis was made by examining all the components used in more than 100 representative subassemblies from current production. A Tools and Fixtures Analysis was made in the fabrication subsection, and an analysis of direct labor in the fabrication subsection was made to determine the relation between setup time and applied time. Other analyses of a similar kind have been made since; but the original studies were the foundation for the systems approach to automation.

With this information it was possible to establish quantitatively the nature of this business and to verify that it is, in fact, low-quantity production of a wide diversity of highly complex electronic equipment. It should be pointed out here that low-quantity production of complex equipment makes for a fairly high engineering content

SMALL-LOT PRODUCERS

• SYSTEMS APPROACH • MANUFACTURING FUNCTIONS • QUALITY CONTROL • INFORMATION PROCESSING



AUTOMATABILITY ANALYSIS
(Normal Routine Only)

OPERATION			AUTOMATABLE		NON-AUTOMATABLE	
No.	Description	Freq	Yes	Technique	No	Reason
1	Check freight bill	1150			✓	O.V. Controlled
2	Check packing slip	1150			✓	O.V. Controlled
3	Check No. of packages	1150			✓	Human decision (Identify source)
4	Compile Rec. list	1150	✓	Analyzing Reader		
5	File Rec. list	1150	✓	Punched Tape		
6	Separate Papers	1150			✓	Human decision (Ident & location)
7	Compile Pack. Slip	115	✓	Punched Tape		
8	Insp. quan. Rec.	1150			✓	O.V. Controlled
9	Record quantity	12			✓	Human decision (Depends on Op. 8)
10	Approval	1150	✓	Mach. Stamp & Staple		
11	Staple	1150	✓	Mach. Stamp & Staple		
12	Transport	1150	✓	Conveyor		
13	Remove from file	1150	✓	Memory Device & Tape		
14	Re-compile P.O.	1150	✓	Punched Tape		
15	Post to P.O.	860	✓	Punched Tape		
16	Insp. quantity ord.	1150	✓	Punched Tape		
17	Compile Inc. material tag	1150	✓	Punched Tape		
18	Transport	1150	✓	Facsimile		
19	Remove form from file	1150	✓	Memory Device		
20	Fill in Form	1150	✓	Punched Tape		
21	Transport	1150	✓	Facsimile		
22	File P.O.	1150	✓	Memory Device		
23	Transport	1150	✓	Facsimile		
24	Transport	1150	✓	Conveyor		
25	Attach tag to Material	1150			✓	Human decisions
26	Transport	1150			✓	Human decisions
		27437	18		8	

Number of Personnel = 11 operators + 1 supervisor

Fig. 1—Example shows use of form for classifying operations as automatable or nonautomatable. Operation is classed as nonautomatable if it requires a human decision, is outside control of the Department, or necessary technology is not available.

in these products—so that automation in the engineering section is very desirable in order to increase productivity.

▶ Determining Automatability

More than this, it was found that the conditions already mentioned led to a very substantial data-handling effort throughout the Department and it was estimated that 80 per cent of this effort could be made automatic. Broadly speaking, data-handling amounts to just over a quarter of the whole activity of this department and is fairly free from obsolescence. Further encouragement came from the Components Parts Analysis which found common denominators among the variety of units produced and thus opened the door to the possibility of creating volume where none had appeared to exist.

Throughout all these analyses—particularly of tools, fixtures, and setup time—indications of potential economic justification of our plans were being established. To show how information of

FORMULAS FOR DETERMINING AUTOMATABILITY

When

A = Number of automatable operations/ routine

NA = Number of not automatable operations/ routine

RA = Relative automatability

$$\frac{A}{A + NA} \times 100 = \% RA$$

When

FO = Frequency of occurrence of an operation / 40 hour week

L_T = Total applied labor / 40 hour week

FC = Figure of complexity

$$\frac{FO_1 + FO_2 + FO_{\dots N}}{L_T} = \text{Operations/person} = FC$$

When

RA = Relative automatability

LC = Labor cost / routine

AJI = Approximate justifiable dollar investment to automate

$$\% RA \times LC = AJI$$

Fig. 2—These simple formulas were developed to assist in producing a weighted list of operations in their order of adaptability for automation.

this type can be rounded up, let us briefly describe the method of flow-chart analysis which was used to determine the percentage of automatability.

Using the form shown in *Fig.* 1, each operation was classified as automatable or nonautomatable. Nonautomatable operations were identified using three criteria: 1. Does it require a human decision? 2. Is it outside the scope of direct control by the Department? 3. Is the necessary automation technology available?

To use the data on the charts, the simple formulas shown in *Fig.* 2 were developed. These three formulas were then used to produce a weighted list of routines in order of maximum adaptability to automation. This analysis established in broad terms the probability of success of automation in the data-handling field. It gave a feeling for the magnitude and complexity of the over-all problem, and set up a framework for the economic justification of the project.

To check these results and get additional data on the other functional sections of the Department, an Equivalent Manpower Analysis was made by taking the duties of each employee and breaking them down into five fundamental work elements—clerical, manual, supervisory, creative, and manual service. This showed the types and distribution of effort. The breakdown was made in the light of representative experience in different sections of the Department and through the use of personnel job descriptions.

Distribution of these five types of work throughout our organization is shown by *Fig.* 3. The implicit necessity of integration when dealing with a type of effort that is more or less evenly distributed through all functional areas is just as important as knowing the individual concentration of certain other types of effort. Clerical work is an example of widespread distribution.

The partial returns from the Components Parts Analysis were used to measure the anticipated volume of components to be handled and to establish common denominators between components (such as wire lead size, wire lead materials, body size, and so forth). The facts that 52 per cent of the components were fixed carbon resistors and that 72 per cent of the carbon resistors were of the half-watt variety were significant because they added up to sufficient volume to warrant mechanization—even though this is far from self-evident when an over-all first view is taken.

Several things may be done to reshape or mold a business to make it compatible with automation. If there are common denominators among prod-

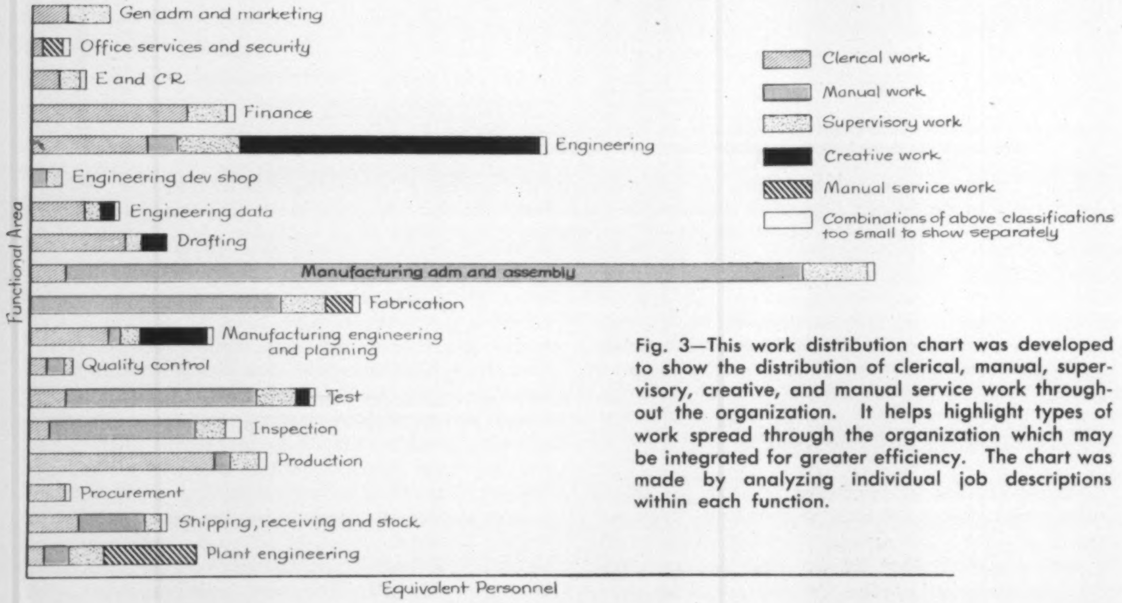


Fig. 3—This work distribution chart was developed to show the distribution of clerical, manual, supervisory, creative, and manual service work throughout the organization. It helps highlight types of work spread through the organization which may be integrated for greater efficiency. The chart was made by analyzing individual job descriptions within each function.

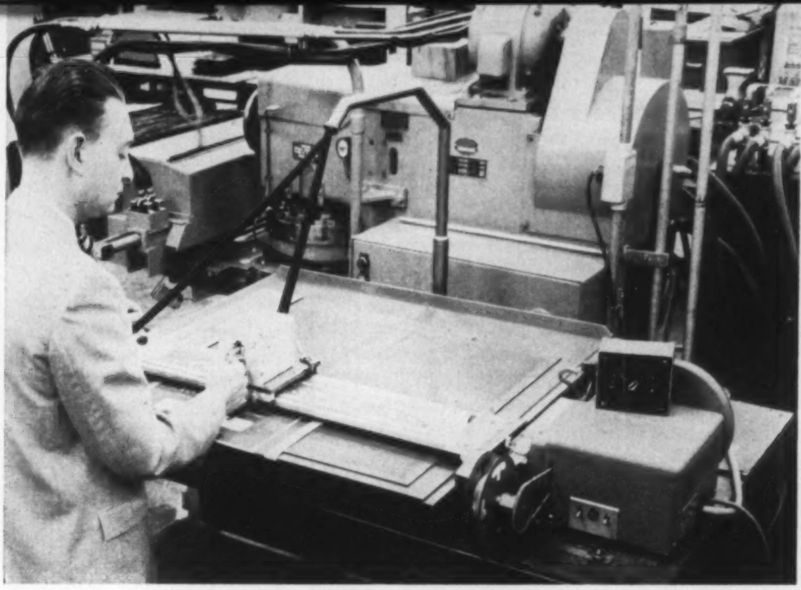


Fig. 4—As part of a system using a tape-controlled punching machine, the product designer lays out desired holes to fall on intersections of a standard grid, and the control tape is generated directly from the drawing on this drawing-to-tape programmer. A stylus is positioned over the specified points and digitally-coded commutators measure the coordinates of the location.

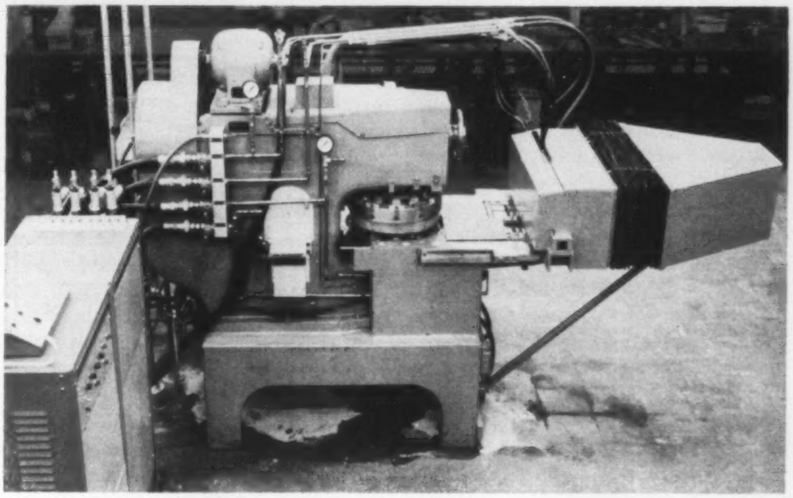


Fig. 5—Punched tape automatically controls this turret-type punching machine for piercing several sizes of holes at desired locations in metal sheets. This machine and techniques for its use were developed as a result of the systems approach and replace a manually controlled machine which used a template for locating desired holes.

ucts, components, materials, processes, or methods, these common denominators can be combined to establish volume. The most obvious tactic is to gather all these likes together in one place. The second and not so obvious method is to create common denominators by control of design through engineering standards.

In our case, the design analysis enabled us to establish location of components as a common denominator. This raises some very interesting possibilities. It makes it possible and economical to accomplish some mechanization in the area of detail drafting, fabrication, assembly, and testing and creates a broadened base for economic justification since a positioning and control device is common to all.

▶ Automatic Positioning

In the manufacture of electronic equipment, punching machinery is used extensively. Sheet aluminum is punched to accommodate terminals, brackets, tube sockets, and a host of other parts. In the manufacture of high-production items, such as radios and television sets, it is economical to build complex tools and dies to punch all of the holes in a given component simultaneously. A large variety of subassemblies produced in small lots, however, demands more versatile factory equipment requiring little setup time. The turret type punch press is quickly reset to punch different sizes of holes. In manual operation, the workpiece is positioned under the punch by the operator in accordance with a steel template. Various colors on the template denote the particular turret position which must be used to punch a given hole. A stylus falling into holes on the template locks the work in position and initiates the punching cycle. This method provides a reasonably versatile and flexible means of piercing sheet metal parts.

The systems approach, applied to the punching operation, has yielded a new way to mechanize the production of electronic equipment. Now, the designer makes a double scale layout over a master grid of vertical and horizontal lines representing a one-tenth inch grid. The intersections of the lines denote points at which hole centers may be placed. When the designer, using the grid and several other standards, finishes the master drawing, the next step is to reduce the drawing to punched tape. To do this, a drawing-to-tape programmer, *Fig.* 4, has been designed which includes a perforated worktable with holes representing all possible grid points, a movable stylus assembly, commutators which are digitally coded to measure the co-ordinates of the stylus location, a hole size selector switch, and a master control unit which processes the coded data and routes them to a tape punch. The master drawing is placed on the perforated worktable and the stylus positioned. Each time the stylus is depressed at a spot indicated by the drawing, information regarding hole size and location is punched into the tape.

To make use of the completed tape in the factory, the operator takes a workpiece which has been cut to size and provided with two positioning holes, clamps it to the positioning mechanism of a tape controlled turret type punch press, *Fig.* 5, inserts the programming tape in the tape reader, and presses the *Start* button. As the tape passes through the reader its coded information automatically directs the punch press until all the prescribed holes have been properly located and pierced.

Thus the systems approach has, in this case, led to the mechanization of a large number of repetitive, monotonous, manual operations. It might also be mentioned here that the mechanized operation provides several opportunities along the line for automatic error correcting features.

Automation Concepts

In the course of carrying out its assignment, the Task Force has developed five major concepts on the basis of the systems approach which possibly are applicable to industry in general without reference to the nature of the product or the size of the market.

Universally Applicable Systems Concept: The most benefits can be gotten from automation when it is thought of as a universally applicable systems philosophy including industrial research, economic analysis, product design, machine design, machine construction, and machine utilization. The over-all systems approach is much more than just the utilization of machinery.

Designing Your Business Concept: It is both possible and desirable to reshape or mold an apparently incompatible business into a form to which automation can be applied.

Systems Planning (Pay As You Go) Concept: Automation can best be approached through an evolutionary, long-range program, based on systems planning. Such a program can be put into effect on a piecemeal basis, with each separate project being economically justified on its own individual merits as well as being justified from an over-all point of view.

Efficiency Concept: Systems planning attendant to a long-range automation program is self-supporting because of recommendations that increase productivity and reduce costs—whether or not the ultimate goal of across-the-board automation is ever achieved.

Do-It-Yourself Concept: The ideal equipment for mechanizing and automating operations within a given factory is normally not available on the open market—or we could all sit back, wait till the salesmen come around, and save a lot of trouble. Moreover, the use of a systems approach presupposes an intimate knowledge of the products and the market for the particular business. So it is best to work with a staff of permanent employees drawn from the appropriate functional sections of the plant organization.

Special Report

SMALL-LOT AUTOMATION

MANUFACTURING FUNCTIONS

By **EDWIN SUURONEN**, Automation Task Force, General Electric Co., Utica, N. Y.

AUTOMATION OF FABRICATING operations has received greatest attention in the automotive and other mass-production industries where high production volume provides economic justification for extensive and costly installation of special machines integrated by means of material handling devices. In those industries where production volume is of smaller proportions, perhaps 50,000 to 100,000 units, it becomes increasingly difficult to justify special machines. Consequently, automation becomes a matter of devising individual parts feeders which supply material to separate machines. Following this line of logic into the short-run production shops where quantities may vary from a few to perhaps a hundred or a thousand, we find ourselves pondering a seemingly unsolvable problem. In this area there just doesn't seem to be sufficient volume of any one thing to yield economic justification even though we may know how to mechanize the opera-

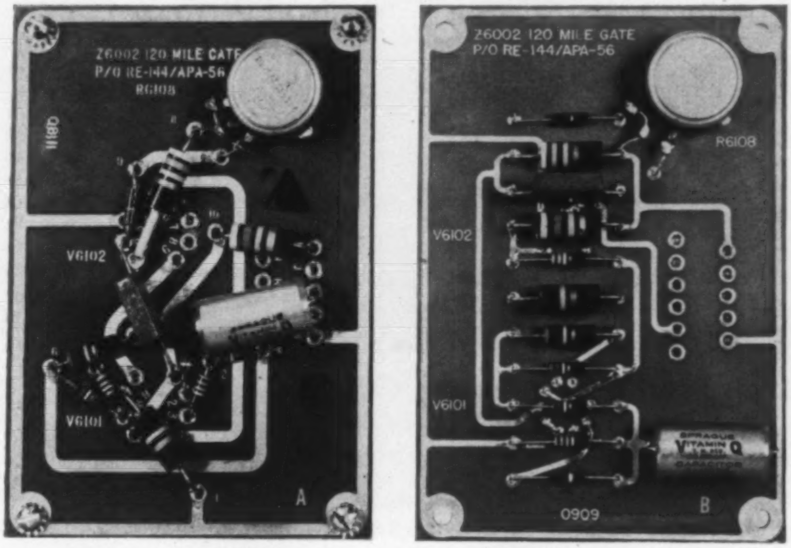


Fig. 1 — Photos illustrate changes made in design of printed wiring board which facilitate automatic component insertion. In the older design (*a*) the layout was designed to obtain shortest wire runs and greatest component density. The newer design (*b*) is based on use of parallel mounting on the *X* and *Y* axes with standard leg spacings.

tion. At this point, most manufacturers throw up their hands and say it can't be done.

Because this viewpoint is widely held, strong arguments are required from another direction to break down the barriers of habit and to stimulate interest in adopting new concepts of automation which are universally adaptable to industry and its various levels of activity.

Automation of short-run production is not only desirable but feasible both technically and economically. However, the approach must be a new one, fundamentally different from that used in high-production industries today. Since high volume is usually requisite to economic justification, it must be created in one form or another and, simultaneously, machine requirements must be simplified through controlled product design. Although production output cannot very well be tripled if the market for the product isn't that great, something can be done in the area of product design to modulize or standardize parts so that the volume of certain characteristics of the product is increased. In the area of tooling, if we had a hole-making tool capable of producing more than one diameter of hole that would be as effective, with respect to machine requirements, as standardizing varying hole diameters into a single size.

▶ Small-Lot Operations

Before going any further into what might be done, we should establish a base of operations in our thinking. To do this properly, the problem must be simplified and a clear perspective of the objective obtained. First, let us define a manufacturing system as an integration of mental and physical actions, combining information, materials, and energy in a predetermined pattern, place, and time so as to create a new material form of economic value.

A look at what is really happening in a typical short-run fabrication operation reveals that the same standard machine tools are used as in medium-quantity production operations and that there is a tendency to use the same basic manufacturing techniques which require special tooling and considerable material handling. This results in a very long manufacturing cycle because of the delay in-

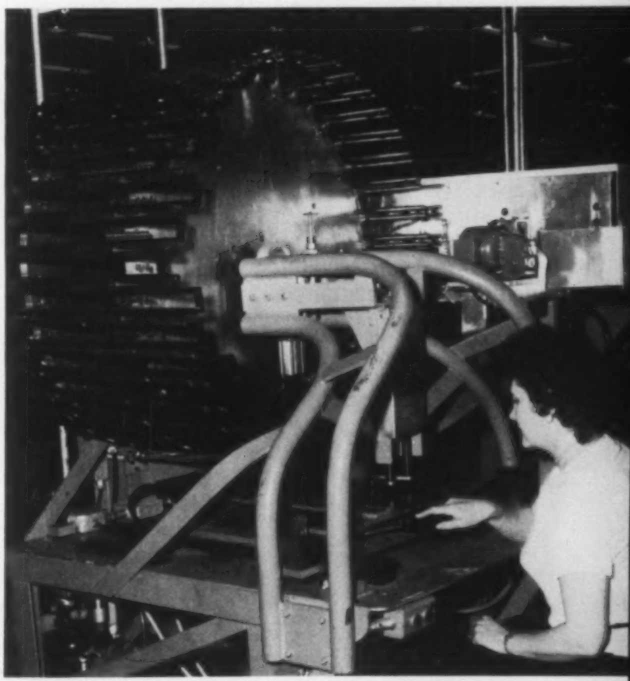


Fig. 2—Components are inserted in the redesigned boards by this automated machine. Different components to be inserted are stored in the magazine drum arrangement.

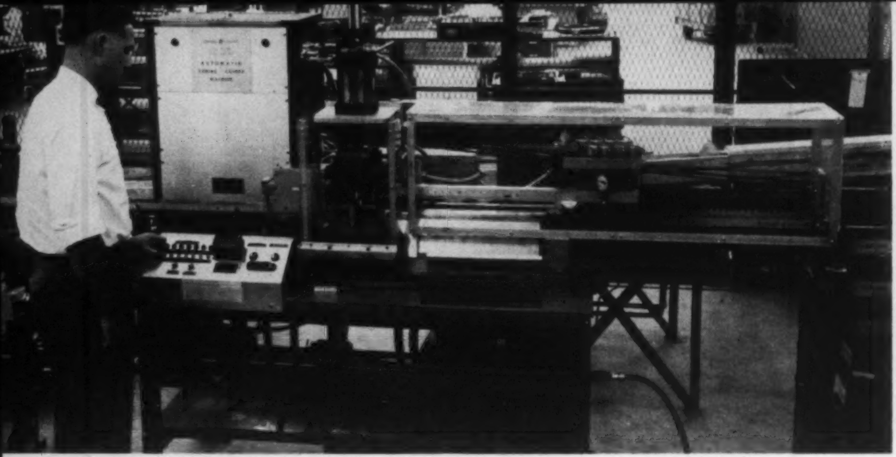


Fig. 3—Square tubing in 20-foot lengths is loaded into this machine and automatically cut off to various lengths used in frames to support wiring boards in electronic equipment. Stock positioning, trimming, cutting to length, and disposal of scrap ends are automatic.

volved in building special tools and setting up the machines before beginning production, and because the large number of parts and separate operations create a difficult scheduling and inventory problem.

Picture raw stock being supplied to a machine which completely fabricates the desired part. Further picture this process being accomplished by programmed means so that a machine operator need do little more than give the machine an occasional assist or a few drops of oil. The advantages of such a situation have immediate appeal. Special tool costs would be eliminated, scheduling problems would be drastically reduced because a single operation would replace several operations, in-process inventory also would be greatly reduced and the manufacturing cycle would be significantly shortened. There would be countless other gains in related paperwork areas.

▸ Developments In Small-Lot Areas

Some of the developments necessary to the creation of the conditions just mentioned include: Multipurpose machines, universal tools, universal fixtures, universal positioning systems, programming techniques, and product design standards. The terms "multipurpose" and "universal" are intended to be only relative. They mean that the machines and tools used should be capable of significantly more flexibility within their general area of operation than is possible at present. They do not mean that a single machine and tool must be capable of fabricating every sort of product. This would be desirable, of course, but that development cannot be clearly seen just yet.

For a picture of what individual short-run manufacturers can do to develop automation, let us look at some of the things being done at our Department where daily production requirements are very low. A. F. Maynard's discussion of the systems approach to the punching operation illustrated three basic developments: 1. Adoption of the one-tenth inch grid as a product design standard. 2. Development of a drawing converter for directly transforming instructions on the drawing into punched tape form. 3. Development of a work positioning system which converts the punched tape instructions into machine or tool control.

Individually these developments would be of less value than as a system; in other words, a system concept permits the maximum benefits. In the application described, automated piercing of sheet metal parts, there are savings in drafting time, in special tool costs, in inspection time, in labor cost, and in manufacturing cycle time. The punched tape which replaces a hole-locating template can be quickly prepared to permit piercing of the first piece in a matter of minutes rather than days. Potential human error of piercing the wrong hole size and thereby ruining the work has been eliminated, and the automated machine remembers to pierce all of the holes in each part.

These developments are equally applicable to printed wiring boards, where an additional design consideration was introduced. Most of the components mounted on printed wiring boards are of the axial-lead type. The component layout on each different board type had always been made to obtain the shortest wire runs and the greatest component density, *Fig.* 1*a*, thus resulting in an infinite variety of patterns when all of the board types were considered.

A study showed that there would be little loss in design flexibility if the components were parallel mounted on the *X* and *Y* axes, *Fig.* 1*b*. It also appeared that the leg spacing of the formed wire leads could be standardized on 1.2 inches to accommodate nearly all of these components. These standards were desirable for mechanized component assembly as well as for the hole piercing operations, and it should be noted that increased manual efficiency will result whether or not mechanization is undertaken.

By the time the component placement machine, *Fig.* 2, was ready for use, miniaturized product designs had come along to shrink the leg spacings of the smaller components. Needless to say, this particular machine would not be economical without provision for handling variable component-leg spacing to meet changing requirements.

There is another related product area where the one-tenth-inch grid design standard and the positioning system have found application. Those printed wiring board assemblies already mentioned are later assembled to tubular steel frames which are themselves assembled from varying lengths of square tubing and interconnecting fittings. The entire frame assembly conforms to the one-tenth inch grid; the square tubing itself is 0.3 inch by 0.3 inch by an incremental length.

In the tubing cutoff operation, the positioning system was applied to provide automatic location of the stop which determines the actual cutoff point. At the present time 20-foot lengths of tubing require manual loading to the machine, *Fig.* 3, and setup is performed manually by operating switches corresponding to the desired cutoff dimensions. Actual stock positioning, trimming, cutting to length, and disposal of the remaining scrap end are performed automatically. A preset counter stops the machine after the desired quantity of parts has been cut to a given length. The machine is designed to permit addition of mechanized stock loading and punched tape programming so that any desired quantity of parts in any desired length can be automatically produced.

General needs for short-run manufacturing have been outlined—but specific needs can be determined only by each producer. A systems concept has long been used in some degree by mass production industries to establish integrated operation. The short-run manufacturer can use the same approach—but it has to be applied more extensively and completely to develop the volume characteristics usually necessary for automation on an economic basis.

One very important reason for choosing the systems approach to automation is that it permits identification of all the major problems so that an over-all plan can be established to meet future needs as well as immediate needs. Projects can then be undertaken with a greatly increased investment safety factor. Short-term projects requiring rapid liquidation because of the obsolescence factor can better be evaluated. Successful automation of short-run manufacturing depends on the systems approach—and only in that manner can we develop the maximum potential in terms of flexibility, efficiency, productivity and profitability—which, after all, are the major goals of a business enterprise.

Special Report

SMALL-LOT AUTOMATION

QUALITY CONTROL

By **LESTER E. McCABE,** Automation Task Force, General Electric Co., Utica, N. Y.

QUALITY CONTROL plays an important part in any manufacturing system, but it assumes added importance in military products in which ever-increasing degrees of reliability are demanded. In quality control for the military electronics industry there are three main functions to be performed: 1. Process control. 2. Functional testing. 3. Reporting.

Relationships between these functions are illustrated in *Fig.* 1. Units such as power supplies, transmitters, receivers, etc. are groupings of subassemblies. A group of intercabled units, in turn, becomes a system—perhaps an early warning radar or a gunfire control system. As indicated by the closed loops labeled *Debug and Repair,* corrective activity is initiated at each level. From this and normal testing activity, failure reports and evaluations are initiated. These debug and repair reports, incidentally, are often the added costs which economically justify automation. Inspection testing is shown in the manufacturing process control area and functional testing in the design evaluation

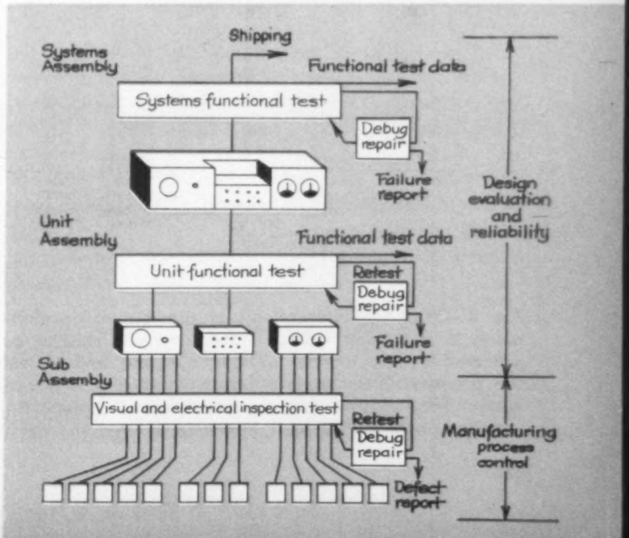


Fig. 1—Sketch depicts relationships between inspection testing, functional testing, and reports to manufacturing and engineering groups concerned with production of military electronic equipment. By inspection testing is meant the testing of components and wiring for conformance to the drawing. Functional testing is testing of equipment for performance in accordance with specifications under operational conditions.

and reliability area. By "inspection testing" is meant the testing of components and wiring to assure that the unit has been built in accord with its drawing. By "functional testing" is meant the testing of equipment under operational conditions to make sure its performance is in accord with customer and engineering specifications. It is of great importance to locate as many defects as possible while the product is in the stage where process control is applicable.

As in the cases of other automation projects, it has been felt necessary to determine the justification for an automation program in quality control. Results of an analysis in which applied labor was compared with test time for various levels of automatic testing are shown in *Fig.* 2. In making this analysis a typical electronic assembly was studied in its manufacturing environment and a conceptual model of 10 production units was devised which approximated the characteristics observed. Using this model it was possible to estimate the amount and distribution of effort that would be required to test this unit with various levels of mechanized or automated test equipment. The characteristics observed in the factory unit and duplicated in the model are as follows: Complexity of the unit—500 wires, 250 components, 20 tubes; number of test values recorded—113; types of defects observed and their distribution in the production equipment; estimate of the time required to locate each type of defect; time required to perform the existing test operations.

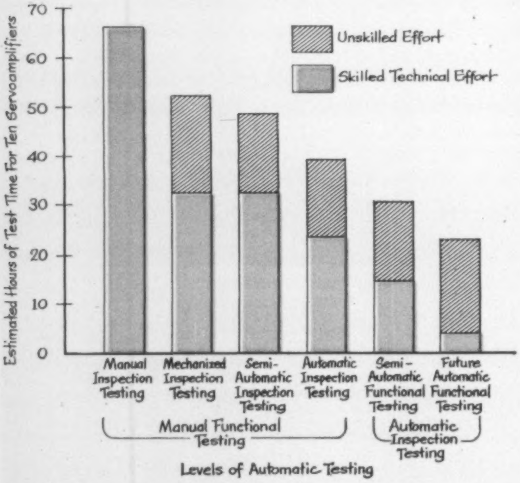
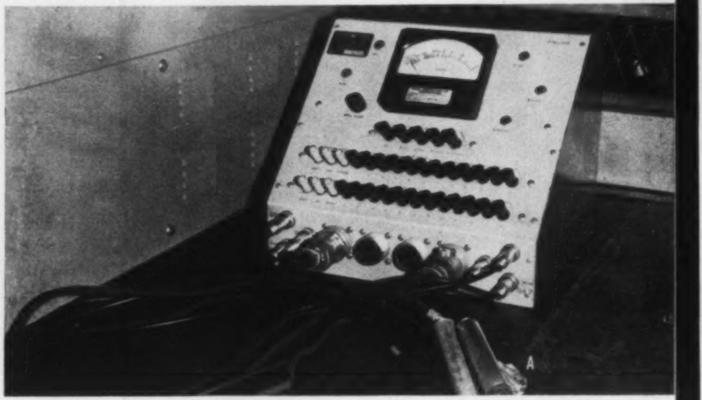


Fig. 2—Chart indicates effects of automation developments in inspection testing and in functional testing as reflected by the number of manhours required to test ten servoamplifiers using different types of test equipment. Total height of each bar represents total hours required, both skilled and unskilled.

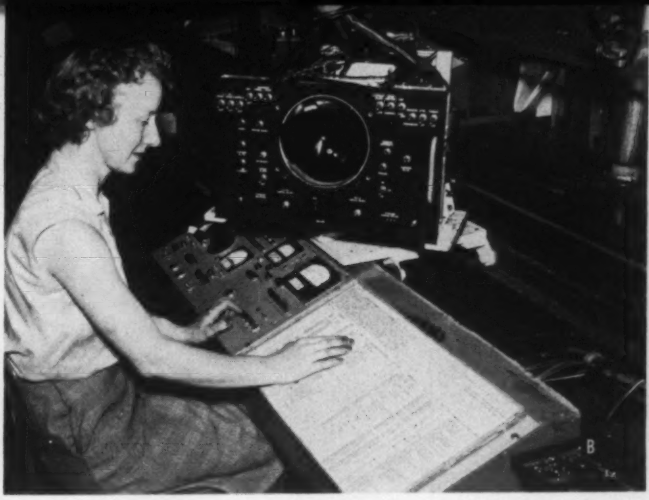


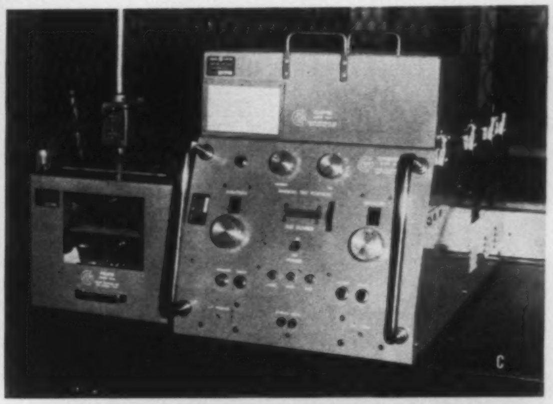
▶ Test History

Back in 1948 a single technician would perform all of the operations to test the equipment completely. There was no specialization to take advantage of levels of skill and pay rates. His first operation would be a wire and component check, prior to turning on the equipment. His efforts were primarily directed toward checking sufficiently to make certain that, when he applied power and started to test under power, there were no obvious defects. Thus, the inspection was cursory in nature and not intended to assure that the equipment was built according to specifications.

After inspection testing the equipment would be repaired and the technician would perform the functional test. These manual operations took 66.4 hours for 10 units. Note that all of this time was expended by a skilled technician. The proficiency required of this man and thus his level of pay was determined, not by the time expended on wire check, but by the experience required to permit efficient debugging of the defective equipment.

In 1949 the division of unskilled testing from skilled testing was begun. The development leading to this approach was the Foster Analyzer, *Fig.* 3*a*. In essence, this equipment was quite similar to the multimeter used by our earlier technician. The Foster Analyzer was essentially an ohmmeter, capable of measuring continuity and resistance with an accuracy of plus or minus 3 per cent. However, it took advantage of the availability of tube sockets and cable connections. With adapter cables plugged into two respective tube sockets on the unit, it was possible to quickly check all wiring and resistance values between the two sockets and to ground or to a common point by simple operation of switches actuated from the pushbuttons on the frontpanel of the analyzer. In this manner, 75 per cent of this circuitry could be efficiently checked in a relatively short time by an unskilled operator. The effect of the Foster Analyzer on the test time required for 10 units was to reduce total test time to 52.7 hours, 33 hours of which were performed by skilled personnel and 19.7 by unskilled operators. This is the





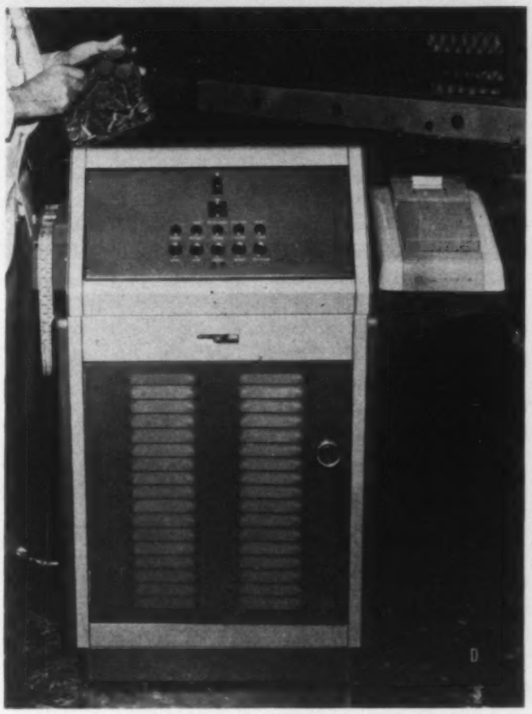


Fig. 3—Photos illustrate progressive developments in equipment for inspection testing of electronic equipment: Foster Analyzer *(a)* which mechanized inspection testing and made possible the separation of relatively unskilled inspection testing from skilled functional testing, stepper switch programmed tester *(b)* considered as making inspection testing semiautomatic, Supertester *(c)* built by Color Television Inc. and typical of equipment available for automatic inspection testing, automatic inspection tester *(d)* developed to measure continuity, resistance, and impedance in accordance with a program punched in a tape and to print the number of any unsatisfactory result.

mechanized inspection testing with manual functional testing shown in *Fig.* 2.

A significant step in mechanizing the Foster Analyzer took place in 1953 with the development of the stepper switch programmed inspection tester, *Fig.* 3*b*. Essentially it performs all of the functions of the Foster Analyzer. However, the program is set up on commercial stepper switches, thus eliminating the moving of plugs and operating of a number of pushbutton controls by the operator in the course of testing. As applied to the servoamplifier unit used as a model, this equipment would cut total test time for 10 units to 49.4 hours, 33 consumed by skilled labor and 16.4 by unskilled. This represents semiautomatic inspection testing with manual functional testing.

In 1954, automatic equipment was applied to further mechanize inspection testing. This equipment was both speedier and more accurate than earlier equipment. The net effect on test time is displayed by the decrease of total test time to 39.3 hours, with a ratio of skilled to unskilled labor now becoming 24 hours to 15.3 hours. This is the automatic inspection testing with manual functional testing shown in *Fig.* 2. A typical example of such equipment, available on the commercial market, is the Color Television Inc. Supertester, *Fig.* 3*c*.

During this same period the use of stepper switches to set up functional testing on a semiautomatic basis was begun. *Fig.* 4*a* presents a typical setup. Programming of the test conditions is established on the stepper switches. The stepper switch actually paces the operator, whose function is primarily that of monitoring the response of meters and recording test data. The operator does not have to program the test sequence for each unit. Once set up properly on the stepper switches, repetitive programming is assured. Test time on most applications has been cut at least in half. This is shown as automatic inspection testing with semiautomatic functional testing in *Fig.* 2. Reflecting these savings of time on the servoamplifier unit model, a total test time of 30.3 hours for the lot of 10 units was obtained—with a ratio of skilled to unskilled labor of 15 hours to 15.3 hours.

▶ Inspection Testing Developments

Thus far two major trends are indicated by this analysis: 1. Faster and more comprehensive inspection testing. 2. Increased speed of functional test-

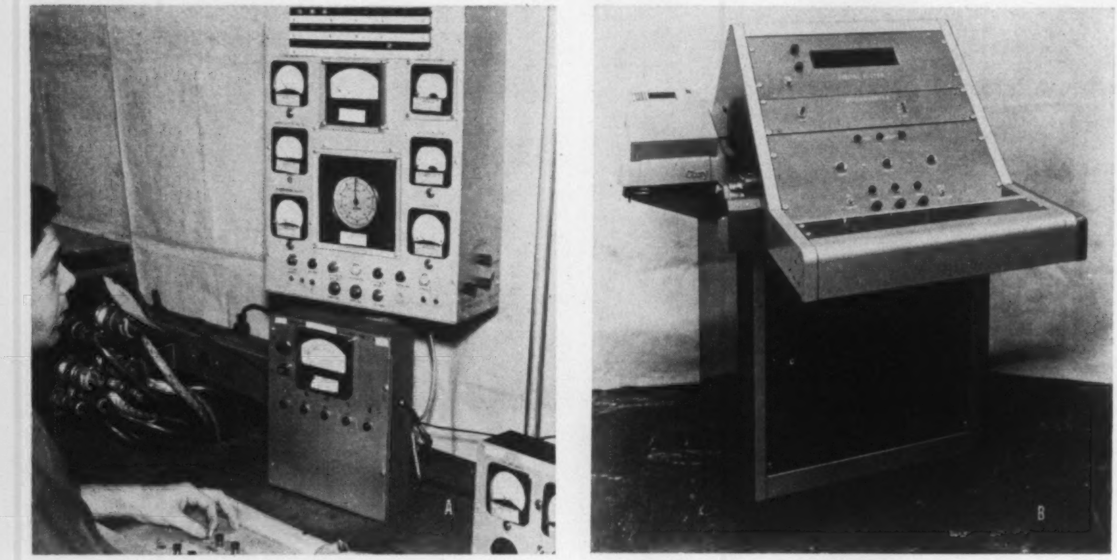


Fig. 4—Progress has also been made in equipment for functional testing as shown here: Stepper switch programmed unit *(a)* which represents semiautomatic functional testing but requires that the operator monitor responses and record test data, tape-programmed functional tester *(b)* which measures performance characteristics, compares each to its limits, and automatically sequences to the next test if the evaluation just made is satisfactory.

ing through the use of semiautomatic programming. These two major trends focused attention on the potential of automatic test equipment applied to all light military electronic products, regardless of production quantity. Investigation revealed that this could be justified if the cost of special tooling could be decreased while realizing the expected saving in manpower. This led to a universal concept of equipment in which it would be necessary to do little more than change a program on punched tape to adapt the test equipment to more than one product. With this broadened concept it is apparent that it is possible to improve process control capabilities and design evaluation techniques. Such gains cannot be realized, however, unless product designs can also be molded to make them more adaptable to automatic equipment. It has been discovered that, in order to realize the potential of automatic testing, the quality control group must work with manufacturing and engineering groups in a team effort. In short, the systems approach must be applied.

In the inspection testing area, a program was started to develop a universal test apparatus to measure continuity, resistance, and impedance—which are common denominators of all inspection testing. In this case, the area of application was broad enough that development of the desired equipment within the Department was possible. The tape-programmed unit that was developed is shown in *Fig. 3d.* It will measure continuity, resistance, and/or impedance according to the program punched in the tape. It prints the test numbers of any tests which are not passed.

This equipment falls short of the ideal in one respect. To adapt it to new assemblies, it is necessary to build a jig to gain access to all test points, in addition, of course, to preparing a new program tape. This jig for test point connections is not hard to build, but it is a special tool. The use of an incremental grid standard has simplified the design of this jig, since it establishes a finite number of points at which to make connections and eases the registration problem. However, the real significance of the application of the incremental grid is the fact that it makes possible the economical development of a universal test-point positioning device which can be programmed both as to test requirements and as to sequence of connections.

The present process control system makes possible continual measurement of the manufacturing quality level, and feeds corrective data to the manufacturing operators on a daily basis. It is hoped that further development of automatic electrical inspection will integrate it closely enough to process control to yield instantaneous feedback.

▶ Functional Testing Developments

The value of developing universal test equipment in the functional test area is also recognized. This development, while not so straightforward as in inspection testing, is equally significant. There are two types of effort involved in functional testing: 1. Segregation of defective from satisfactory equipment. 2. Troubleshooting.

The first operation is essentially a repetitious type of job and can be delegated to a machine. The troubleshooting task is a technical job involving the know-how of technicians. Automatic functional testing will do the sorting operation and free the technician to spend his time in the troubleshooting area. Potential value of such an achievement can be appreciated from the fact that technicians now generally use about 75 per cent of their time in routine testing and alignment procedures as opposed to 25 per cent used in troubleshooting efforts which effectively utilize their technical training.

Since automatic equipment is relatively expensive, a broad base of application must again be provided. Standardized modular product design work by engineering must be encouraged. The concept of the automatic test equipment must be such that standard building blocks can be integrated physically or by programming to test a wide range of products. These standard building blocks will include a tape reader, a programming device, a recording device, and measuring equipment capable of measuring ac or dc voltages, phase shift frequency, time interval, etc. That such a program is not too optimistic to be considered now is evidenced by the technological advances of the past few years. During this time we have seen the development of digital voltmeters which can measure and record in less than a second ac and dc voltages over a range from 10 millivolts to 1000 volts with an accuracy of 0.1 per cent. Actual measuring time is only milliseconds. Some equipment can even perform this operation in microseconds, which indicates the possibility of its use as digital waveform analyzers.

The automatic tester displayed in *Fig. 4b* performs a complete functional test on a unit in current production. This equipment is tape-programmed, utilizes a digital voltmeter for measuring functional performance characteristics, compares each result to its limit value, and sequences to the next test after an evaluation of the previous result. Evaluations are made before advancing to the next test because failure of a given test condition may make it judicious to stop the sequence rather than risk a catastrophic failure. The impact of automatic functional testing is indicated as automatic inspection testing with future automatic functional testing in *Fig.* 2. In this case, total time for 10 units becomes 21.9 hours with a ratio of skilled to unskilled labor of 3.3 hours to 18.64 hours.

Our program is based on a recognition of overall need and of the direction in which we want to go. Reduction to practice is piecemeal, based on an appraisal of the economics of each project. With this program we expect to progress to the established goal of universal automatic functional testing in a practical, evolutionary manner and yet keep the program essentially self-supporting. We do not have—nor do we see—the solution to all of the problems in the development of automatic functional testing. The task is not an easy one, but as we gain more experience with automatic functional test equipment, we are establishing its limitations and an understanding of the form of product design we need from engineering in order to expand our automation program. Standardized designs will foster further refinement of our automatic test equipment. These developments will go hand-in-hand. The rapid development of instrumentation leads us to believe that instrumentation will not be the most significant limitation to our progress. The real challenge is the establishment of realistic design standardization which will foster the economic justification of automatic test equipment for our lowest production quantities.

The importance of the relationship between hardware developments and product standardization should not be overlooked, for if automatic test equipment was commercially available today, it is doubtful our program could move much faster. The significant point to consider is this: An automation program cannot be bought; it must be developed to the needs of the business. To fail to carry out this development is to jeopardize future competitive position with respect to those who do.

Special Report

SMALL-LOT AUTOMATION

INFORMATION PROCESSING

By **RUSSELL P. MILIOTO,** Automation Task Force, General Electric Co., Utica, N. Y.

INFORMATION HANDLING is fundamental to any manufacturing system. The amount and types of information to be processed have steadily increased due to the growth of business and government. The data processed in the normal routine of designing and building a product account for no more than half of the total data-processing load. Government requirements, employee benefit systems, control activities, and the like account for the remainder of the effort.

When we speak of an automated data-processing system today, we are referring to a system that can meet all these requirements.

Data-processing effort requires 26.6 per cent of total personnel in our Department, and it is estimated that 80 per cent of this activity is automatable. It might be added that the measured volume of paper to be processed each year is more than six million pieces. This represents a situation almost the exact reverse of the manufacturing environment described in E. Suuronen's article. In that environment, the problem was to find or build volume where it apparently did not exist.

In the case of information handling generally, volume does exist abundantly, normal conditions favor automation, economic justification looks favorable, the paperwork is relatively free from obsolescence and likely to increase in volume, and the technology and many machines are available. The only thing lacking is the systems planning for specific jobs. Our systems approach has already been stated as the formulation of the needs of each part of the system from an understanding of the whole system. In using this approach the following program was followed: 1. Formulate the ideal system. 2. Compare the ideal system with the detailed analysis of the operating system. 3. Investigate current technology and machines. 4. Plan the system. 5. Review the system with people from all functions of the Department. 6. Recommend the system to management.

To state desired characteristics of the ideal data-processing system was a relatively easy task; such a system applies the following: 1. Productive routines. 2. Direct communications. 3. No duplication of effort. 4. Shortest over-all time cycle. 5. Source data recorded in a form which permits mechanized reuse of the source data. 6. Simple routines. 7. Control by exception. 8. Control by over-all scheduling.

The implications of most of these characteristics were self-evident; but with the others the ramifications and far-reaching effects became evident only when they were investigated. Direct communications, no duplication of effort, and the shortest over-all time cycle are in this latter category. For example, what are the full implications of direct communications? The most direct communication route that could be envisioned was direct control of factory machines during the design cycle of the product.

In order to accomplish direct machine control from the designer's effort, the planning, procurement and production needs must also be simultaneous inputs to the system at that point. The relocation of planners and production personnel side by side with engineers is one method of obtaining this parallel input.

Such an arrangement as this would also go a long way toward meeting the objective of no duplication of effort since the majority of the effort of planning, production, and procurement stems from the reuse of engineering information. A de-

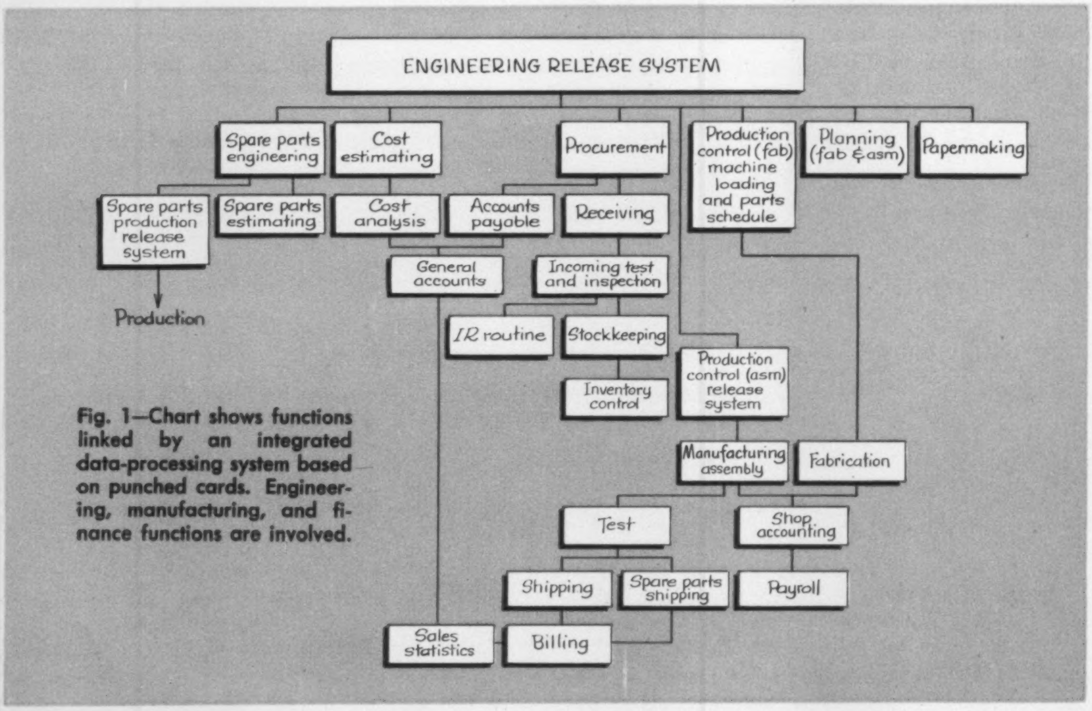

ENGINEERING RELEASE SYSTEM
Spare parts engineering
Cost estimating
Procurement
Production control (fab) machine loading and parts schedule
Planning (fab & asm)
Papermaking
Spare parts production release system
Spare parts estimating
Cost analysis
Accounts payable
Receiving
Production
General accounts
Incoming test and inspection
IR routine
Stockkeeping
Inventory control
Production control (asm) release system
Manufacturing assembly
Fabrication
Test
Shop accounting
Shipping
Spare parts shipping
Payroll
Sales statistics
Billing

Fig. 1—Chart shows functions linked by an integrated data-processing system based on punched cards. Engineering, manufacturing, and finance functions are involved.

signer and a planner duplicate the thought process of how a part will be fabricated. The same items of identification, project number, quantities, schedules, and planning operations are repeated over and over. This leads to the conclusion that the ideal system will be one in which each record is created only once and updated and altered as the project is processed. Can this be accomplished?

The answer is yes, but not with existing systems and routines. It is necessary to have a centralized data storage which contains all records in a form accessible upon demand at the point of use. The technology for designing and building such a system is already available, but the systems planning and economic justification are the unknowns.

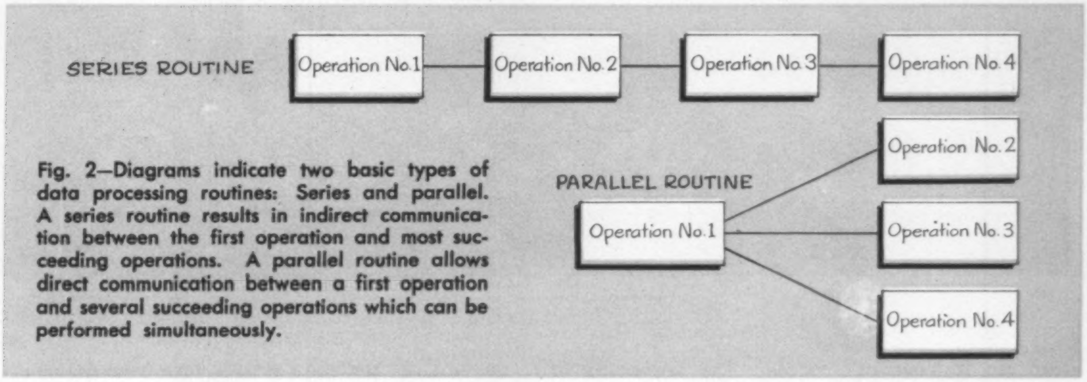


Fig. 2—Diagrams indicate two basic types of data processing routines: Series and parallel. A series routine results in indirect communication between the first operation and most succeeding operations. A parallel routine allows direct communication between a first operation and several succeeding operations which can be performed simultaneously.

▶ Creating A Data System

First considered in our systems planning effort was the use of the digital computer. The computer was considered in the light of ultimately accomplishing the idealized system in which records are created only once. That existing computers would not do this job is perhaps best illustrated by the fact that the memory capacity required to accommodate our finance records alone was calculated at 77,893,800 characters, and this measure of present needs was in no way indicative of final needs. It was also recognized that any change in system must be accomplished with an "Open for Business" policy in effect because of commitments to customers and our selfish desire to continue getting pay checks.

In light of these conditions, an integrated data-processing system using punched cards was proposed and implemented. The selection of punched cards was made because of the availability of equipment, because the cards generated in this system could be regrouped and studied to further re-evaluate the data-processing system, and because punched cards are a direct or indirect input to all types of digital computers.

Functions being integrated by this punched-card system are shown in *Fig.* 1. At this time, engineering, manufacturing, and finance are involved. Certain aspects of marketing and employee and community relations are now under consideration. About 60 per cent of this program has been implemented and routines for all but two areas (shipping and billing) have been planned in detail.

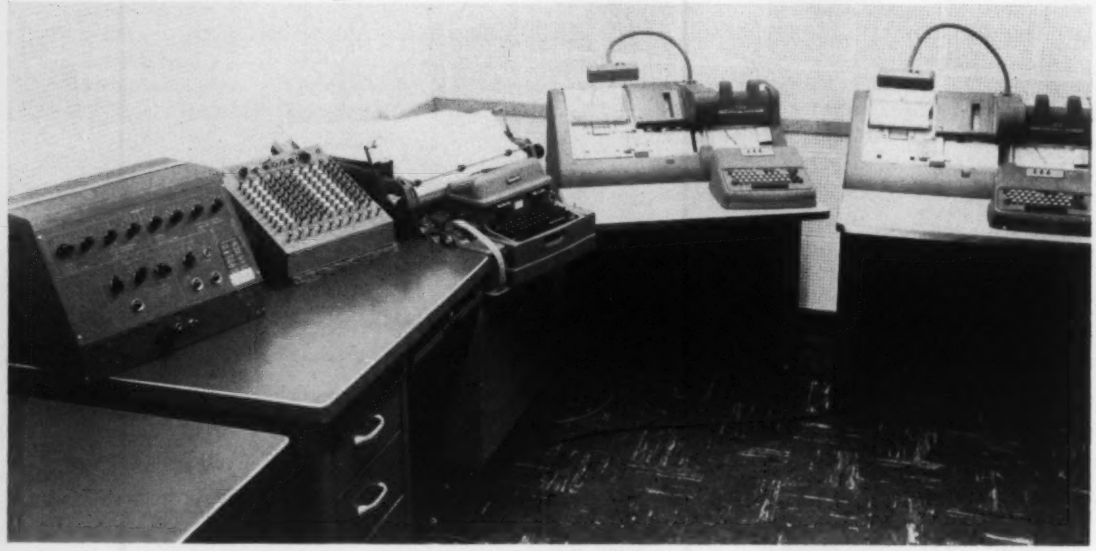
The engineering release system shown at the top of *Fig.* 1 as the input to the over-all system was the first data-processing project undertaken by the Automation Task Force. Analysis of flow charts showed that what had been a series operation could be converted to a parallel operation, *Fig.* 2, thus giving the shortest over-all time cycle. It was found that, by moving production men into the engineering area, engineering information could be released with production requirements and schedules already processed and included. In the same manner, factory routing information is established by having factory planning people located with drafting personnel. The results justify a certain amount of pride since the elapsed time between the release of engineering information and the availability of this information at the point of usage was shortened by more than three weeks.

Changing from series to parallel operation and reorganization are things that could be done without mechanization of the routines. This is an example of our "Efficiency Concept"; the improved routines alone would more than compensate for the systems planning effort; mechanization is an added gain.

Another advantage of a mechanized punched-card system is that punched cards can be sorted by requirements such as fabricated items, purchased items, and common stock items. Cards are thus segregated by function, allowing direct transmission to any given group of only that information with which it is concerned. Punched-card processing may then be carried out in a simplified manner in each area.

For the most part the use of standard punched-card equipment is adhered to, but there have been several areas where it has been necessary to apply

Fig. 3—Data processing machine system developed by the Light Military Equipment Dept., General Electric Co., processes data covering spare parts for their products. Two IBM key punches, a Flexowriter, an auxiliary keyboard, and a control box are integrated to form a flexible system.



the "Do It Yourself" concept. The processing of spare parts is one such area where it has been found faster and better to develop a tailormade machine system. The spare parts procedure, due to our type of business and the complexity of our products, is rather lengthy and involved. Spares are usually selected by the customer after a provisioning team has reviewed each individual item that makes up the entire piece of equipment. This necessitates the preparation of lengthy lists, put together in bits and pieces. To do this job the machine system shown in *Fig.* 3 was developed by integrating two IBM key punches, a Flexowriter, an auxiliary keyboard, and a control box. This system can have manual, punched card, and punched tape input and obtain printed document, punched card, and punched tape output.

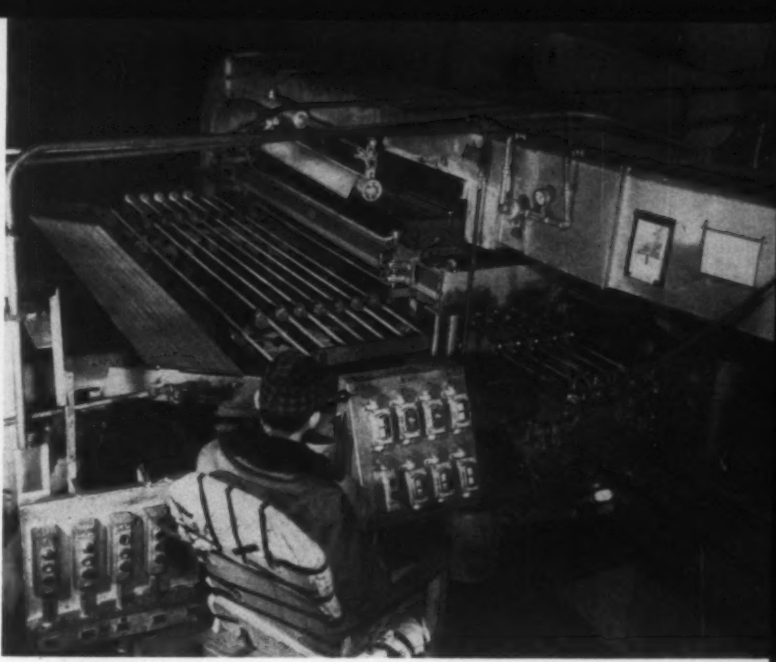
Punched cards prepared by the machine system become the input to a mechanized cost-estimating function which prices selected spares. These estimated prices are then used in spare parts exhibits for billing to the customer. It is of interest that the development and building costs for this integrated machine system were written off by savings during the first year of operation.

▶ Future Data Processing

It is expected that data processing will radically change the control concepts in general use today. For example, cost figures which have been the means of top management control for many years will become a generally used control at the lower levels of management and supervision. As pointed out in L. E. McCabe's article, data from the quality control effort is necessary if the operating sections are to maintain and improve functional performance. Test data are presently taken on mark-sensing cards, which are then machine-converted to punched cards. These punched cards are machine-analyzed and the failure and defect reports prepared by means of punched-card tabulating equipment.

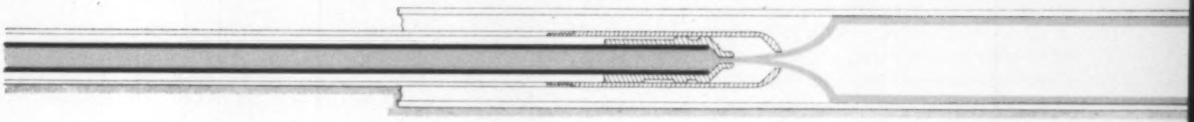
Real time processing should become an actuality in the near future. This is the idealized manufacturing system in which all source data such as design requirements, planning sequences, production schedules, and the like are fed into a mechanized memory. One can readily visualize the tremendous amount of unproductive effort and duplication of records that is eliminated by such a system. The desirability of mechanized machine scheduling of work loads has long been recognized; and, if this can be coupled with the control of the factory machines within the same data-processing equipment, the picture becomes more nearly ideal.

We believe that we stand on the threshold of a new industrial era in which the extension and development of automation and automation understanding will take us far down the road to the automatic factory. We hope our philosophy and description of our practices have been stimulating and provocative to the point that the reader will see fit to give the matter further consideration. The extension of automation beyond the realm of mass production is both a challenge and a necessity if we are to meet the requirements of tomorrow's business.



1

Automatic operation for the painting machine starts when L-shaped phenolic block carriers rotate beneath an inclined hopper and load individual lengths of conduit on the conveyor. The blocks are mounted on 4-inch centers along parallel chains of a continuous conveyor which is driven by a 1-hp hydraulic motor. Each time the conveyor moves 20 inches or the space occupied by five tubes, rotary cams synchronized with the conveyor travel trip two limit switches. One switch actuates a solenoid valve to shut off the hydraulic conveyor motor, and the other switch initiates the next automatic operation. The illustrated machine is installed in an integrated process line and receives material by conveyor from a previous operation at the left.



AUTOMATION TODAY

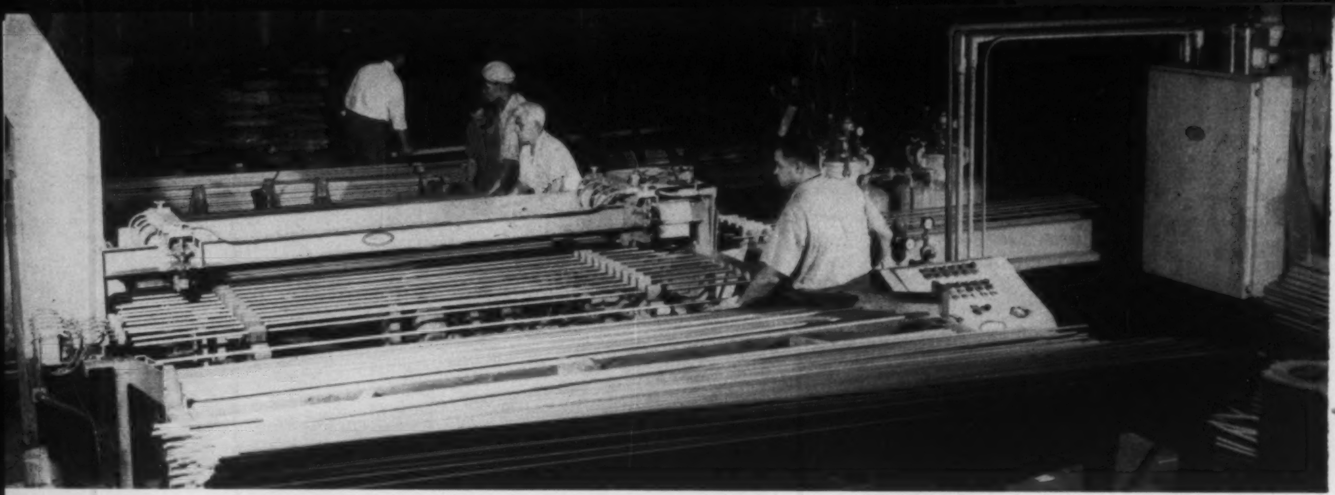
AUTOMATIC SPRAY PAINTING

OF ELECTRICAL CONDUIT

By **ERIC H. COCKS**, Plant Manager, Eclipse Air Brush Co., Newark, N. J.

ECONOMICAL manufacture of electrical conduit requires the use of a high-speed, automatic painting machine to coat the interior surfaces of the conduit. Lacquer, enamel, varnish, or synthetic material may be used for this coating to provide insulation qualities, prevent corrosion, and present a slick surface as an aid in pulling wire through the conduit. The coating must also be flexible to prevent cracking when the conduit is formed at installation and must have excellent adhering qualities to prevent peeling or flaking while in service. In addition to normal production control specifications, each piece of conduit must meet Underwriters Laboratory requirements in order to receive the UL label before shipment.

Several years ago, and in some cases today, the inside coating of the conduit was applied by an operator manually inserting a hose nozzle and flowing the coating material through the pipe. In other cases, where both the inside and outside of the conduit were to be painted with an identical



2

Another painting machine is shown installed in a batch type process line of a small plant. Material is transported to the machine by overhead crane, bundled by hand after painting, and carried by lift truck to the shipping department. An air dry lacquer is used as a coating medium, eliminating the necessity for drying ovens. The following series of photographs were made of this installation.

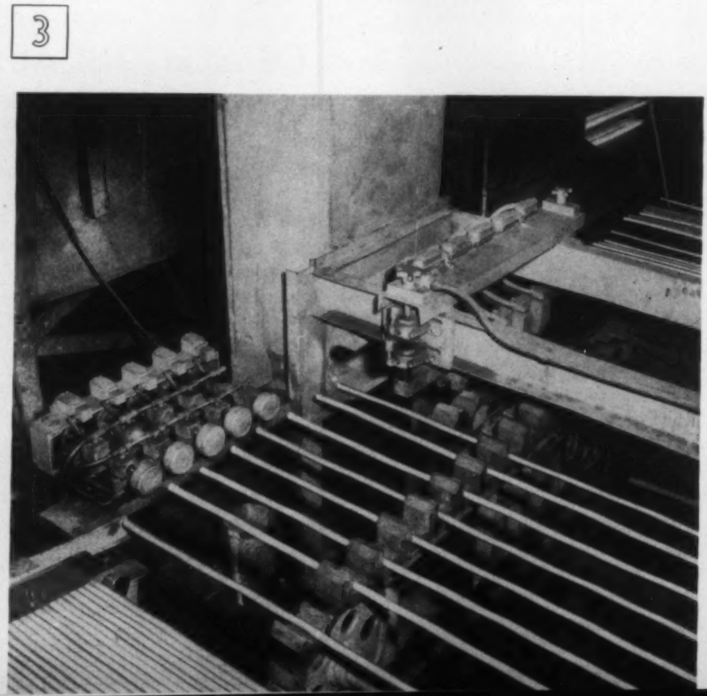
coating, the lengths of conduit were placed in a basket or spool conveyor, dipped into a large painting tank, and hung to drain. Both of these types of process required considerable manpower, large floor space, and excessive handling. In addition, they were very inefficient and usually applied more coating material than was necessary to produce an acceptable product.

In order to increase production and use modern coating materials, methods of automating conduit painting were investigated by Eclipse Air Brush Co. Several machines were built and installed in various plants manufacturing conduit. It would be apropos to discuss the various design considerations that evolved from practical experience gained with these early machines and from discussions with the people who operated and maintained the machines. The designer must first recognize that the use of a coating medium in a machine presents many problems of design which are not normally of importance in other types of equipment. Of extreme importance is recognition of the fact that, due to the type of operation involved, the equipment will probably be neglected. Therefore, all mechanical parts of the machine should be designed to take more than normal abuse without failure. Tolerances between parts should be generous so that normal accumulations of paint will not stop the machine. The operation of the painting machine should be as foolproof as possible, need little operator attention, and require an absolute minimum of maintenance.

Specific considerations of design should include

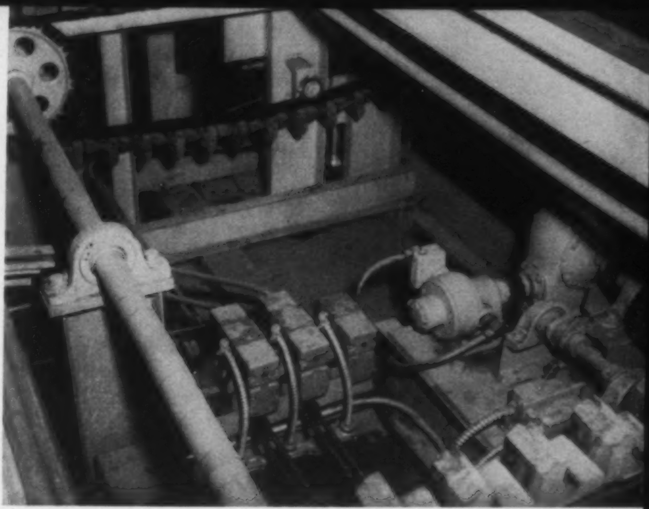
3

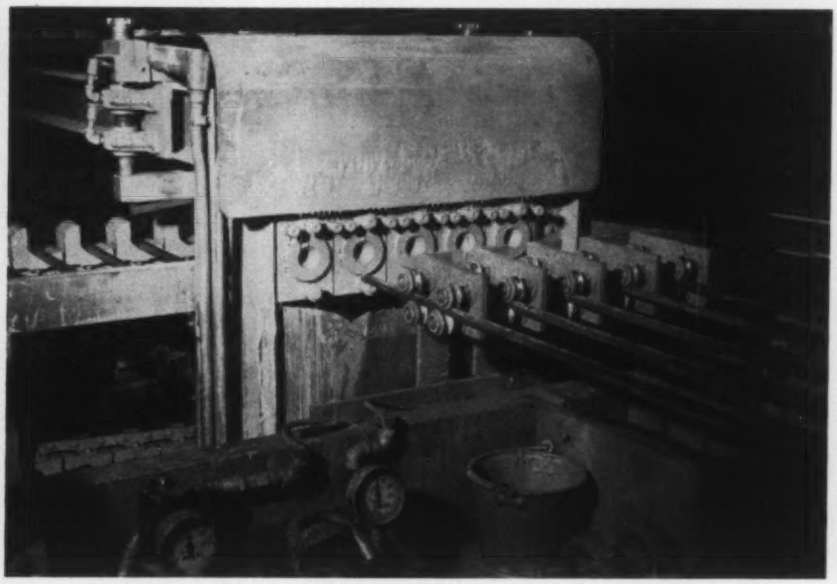
Before painting, each length of conduit is individually aligned and checked for length. The conveyor has stopped at this point, and five double-acting cylinders push the tubes against positive stops. The rear end of each double-end piston rod has a boss which actuates two limit switches—one above the cylinder and one below. If the piece is either long or short, one of the two switches will remain open and shut down the machine. Indicator light on the operator's control panel signals that a piece of tubing is faulty. Operator presses a button and a series of lights indicate which piece is bad. This piece is replaced, rechecked for tolerance, and the machine continues in operation if the new piece is satisfactory. After the checking cycle, the conveyor starts, moves the aligned conduit 20 inches, and stops. V-shaped phenolic blocks, shown under the beam support and adjacent to the conveyor, lift the five pieces into the spray position.



4

Hydraulic drive motor for the conveyor is located under the spray units. Two rotary cams, lower right, are synchronized with the conveyor travel to trip limit switches and stop the conveyor every 20 inches. Four solenoid operated hydraulic valves, mounted on the manifold to the left, control the drive motor, two lift cylinders, and one spray cone cylinder. The lift cylinders raise five pieces of conduit on V-shaped blocks into spray position and hold them against the alignment clamps for each piece. Behind each clamp is a limit switch that must be closed before the next part of the cycle occurs. If one of the lengths is misaligned, the cycle will stop until the operator corrects the difficulty. The entire clamping system, including the limit switches, is adjustable for centering on different sizes of conduit. This eliminates the necessity of moving the spray nozzles when changing over to runs of different size conduit.





5

As soon as all the limit switches on the clamping assembly are closed, a hydraulic cylinder moves a set of spray cones over the tube ends on the operator side of the machine. These cones serve to guide the spray nozzles into the five tubes and prevent excess spray from blowing on the outside of the pieces on the return (painting) stroke of the nozzles. Each cone "floats" on a set of springs and bushings which compensate for any misalignment of conduit. Spray nozzles are inserted on the end of long spray extensions which, on small sizes of conduit, slide on the lower half of the interior of the conduit. On larger sizes of conduit, a small adapter is slipped over the end of the nozzle to help maintain the path of the nozzle along the centerline of the tube.

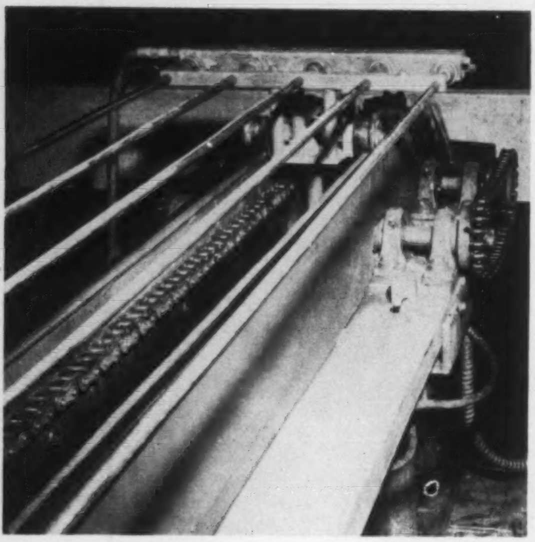
means of rapidly converting the machine to different sizes of conduit since production runs can vary from ½ to 6-inch diameter stock. The design should include provisions for centering the conduit in front of spray nozzles without having to move the spray means up or down for various sizes. Various methods of actuating the sections of the machine should be carefully investigated. Hydraulic, pneumatic, or electrical actuating systems can be used singly or in combinations, because all three systems have definite advantages and disadvantages when used in connection with a coating medium. Care should be applied in selecting valves for pneumatic and hydraulic systems since they usually require special packings to resist attack by the coating medium used. Valves used directly in the paint lines should be selected so that their operating unit will exert sufficient force to overcome the tendency of the valve spool to jam when the packings become swollen through contact with solvents used in present day paints.

The automatic high-speed painting machine illustrated with this article can be used as an integrated part of a continuous processing line or can be set up as a separate operation in a batch type process line. In either case, the painting machine is capable of processing up to 40 pieces of 10-foot conduit per minute, and is adaptable to both rigid and thinwall types varying from ½ inch to 6 inches in diameter.

Conduit is transported to the painting machine by materials handling means and is loaded into an inclined hopper. The following automatic operations are performed by the machine: 1. Pick up each piece on L-shaped carriers mounted on 4-inch centers on a chain conveyor. 2. Align ends and inspect for length. 3. Lift from chain conveyor and clamp in spray position. 4. Encase ends with spray cones. 5. Spray interior with coating medium. 6. Withdraw spray cones and lower pieces to chain conveyor. 7. Discharge pieces from conveyor to an inclined hopper for the next operation.

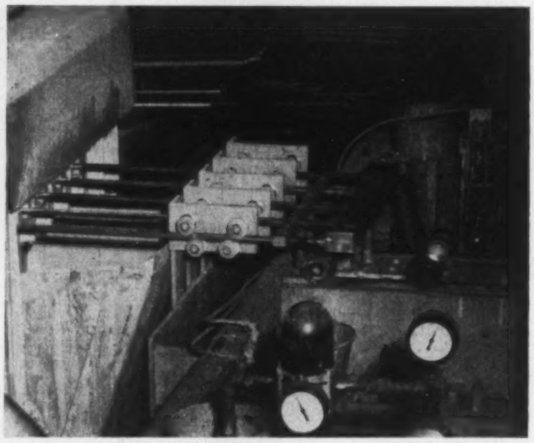
Over 40 limit switches are used in the painting machine to control and interlock each operation. As one operation is completed, limit switches actuate the next cycle until the entire process of painting is finished and the lengths of conduit are discharged from the machine. Three different systems—electrical, hydraulic, and pneumatic—have been integrated into the design of the machine to control or actuate various parts of the process. The machine is fully automatic and requires a minimum of attention from the operator. Once the machine has been set for automatic operation, the operator normally only uses *Cycle Start* and *Cycle Stop* control buttons to correct difficulties picked up by the interlocked limit switches.

Accompanying photographs illustrate details of this machine.



6

Five spray nozzle extensions are fastened into a manifold which is connected by flexible tubing to the paint containers and the air supply. The manifold is mounted on a reciprocator carriage that rides on hardened steel tracks and moves the nozzles into the interior of the tubes. The reciprocator unit is driven by a ball bearing link connected between two drive chains. This link rides in a slot in the carriage and the unit is reversed when the link travels around a sprocket at the extreme end of the stroke and slides down the slot. On the return stroke of the reciprocator unit, the nozzles spray the insides of the tubes. The unit is driven by an explosion-proof geared brake motor which permits changes in speed for larger sizes of conduit.



7

View shows the spray extensions fully extended into the tubes. The movement of the reciprocator carriage trips limit switches which actuate the pneumatic cylinders to align and check the next five pieces of conduit to be painted. At the conclusion of the paint cycle a limit switch is actuated by the reciprocator returning to its home position. This action causes the spray cones to retract and the hydraulic lift cylinders to lower the lengths of conduit onto the chain conveyor. Limit switches on the bottom of the lift cylinders close and start the conveyor for another 20 inches of travel. At the end of the conveyor, the tubes drop into an inclined hopper for storage until the next operation.

8

Operator's control panel is adjacent to the paint machine in the foreground. Electrical components such as relays and time delay units are mounted in a panel which is easily accessible for maintenance. Paint is supplied to the manifold from two 50-gallon pressure containers located behind the reciprocator track. Each tank is fitted with an air motor driven agitator which insures that solids are thoroughly distributed throughout the paint mixture. One container is used to feed the manifold, and the other container serves as a standby for quick changeovers. A small 12-gallon tank is also connected to the manifold for flushing thinner through the paint lines at shutdown.

DIMENSIONAL CONTROLLING SYSTEMS

3

COMBINATION GAGING SYSTEMS

In-process and post-process gaging elements can be combined into a single control system. The result is an advanced form of control where a gage sets a gage to obtain sustained control of production, compensating for drift and recognizing random variations.

By **R. ALLEN SOULER**, Automatic Gage Engineer, Federal Products Corp., Providence, R. I.

AN ADVANCED control technique which brings machine operation significantly nearer to complete automation involves combined gaging—the use of control gages both during and after a machine operation. Two previous articles of this series have discussed in-process and post-process gaging systems. To complete the picture, this final article will highlight the advantages of combining the two types of systems into a single advanced system of control.

In-process gaging is usually confined to the control of a simple machine response. A typical example would be a grinding machine installation in which the feed rate of the grinding wheel is changed when the work size reaches a point close to final dimension and the wheel retracted when the final dimension has been reached, *Fig.* 1. Post-process gaging is concerned with the classification of a successive number of workpieces and the collection of sufficient information to check the possible need for stopping or correcting the machine, *Fig.* 2. This type of gage control can compensate for drift in machine settings, before rejects occur, by acting when pieces fall outside preset marginal limits which are still within specified part tolerance limits.

In-process gaging must exercise control over random size variations under conditions that are considerably less than ideal. Because of the location of the gaging equipment, such systems are not completely immune to the effects of temperature fluctuations in coolant, workpiece, or the machine itself. This type of system, however, has the great advantage of involving a minimum of equipment. Inherently, it provides a high degree of efficiency, because its control is exercised while the piece is being made. Its functioning, as has been noted, involves a simple machine response, primarily that of tool retraction at the proper time.

A post-process gage, on the other hand, while controlling machine drift and also compensating for size variations which might not have occurred had there been control on the machine, has the ad-

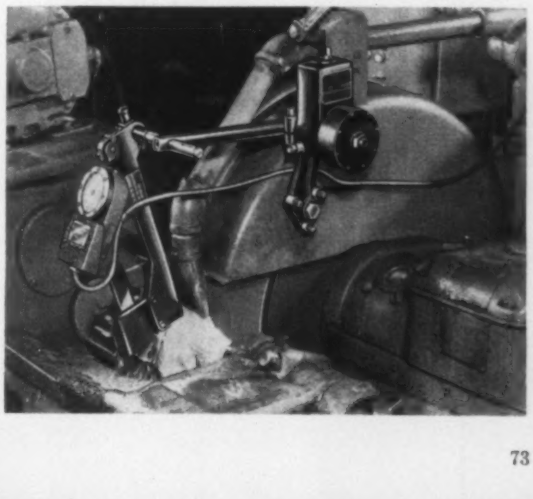


Fig. 1—Example of in-process gaging. Upon gage sensing that workpiece has reached desired dimension, control signal will cause wheel to retract.

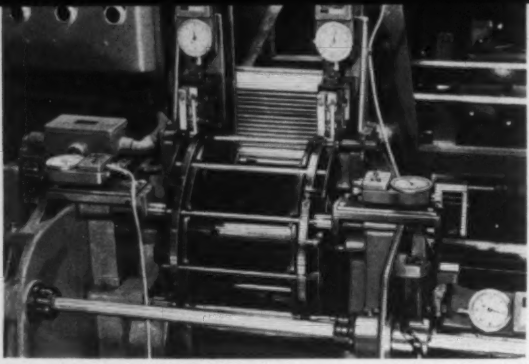


Fig. 2—In post-process control by gaging, parts are checked for conformance to desired dimensions after machining process. If excessive number of rejects are sensed, control will cause machine to stop for operator action.

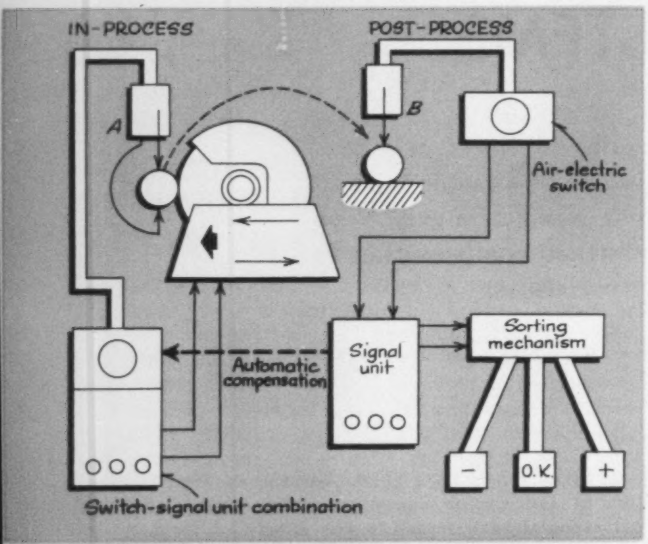


Fig. 3—Sketch of combined gaging system for control of grinding operation. In-process gage retracts wheel when work reaches finish size. Post-process gage inspects and sorts work into proper size categories. When post-process gage senses drift toward marginal tolerance limits, it signals in-process gage to reset its wheel retraction point.

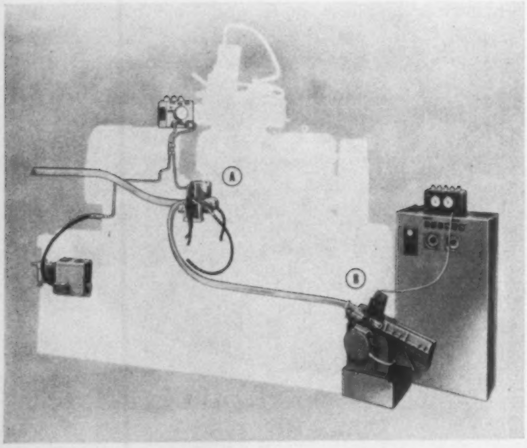


Fig. 4—Combined gaging system as it might appear on machine. In-process gage, A, receives control point adjustments from post-process gage, B. Measurements of machine movements are not required.

vantage of operating under more stable conditions. More equipment is involved, but the gage has the ability to classify work into numerous size categories and to halt the entire operation if corrective action, signalled by the gage, is not carried out by the machine.

A combination of the elements of the two systems for the control of a single operation logically has the advantages of both and, less logically but quite happily, overcomes the major limitations of the individual systems. The post-process gage monitors the performance of its companion gage on the machine and, when correction is necessary, sends compensating signals to the in-process gage, which resets itself either in established increments or by an amount equal to the size variation noted by the post-process unit. In controlling work size from its new setting, the in-process gage on the machine (not the machine itself) automatically compensates for operational variables, *Fig.* 3.

Combined gaging has been applied to both cylindrical and internal grinders. In both cases the gage must be able to reset its zero or wheel retraction point without affecting the linearity of response or magnification factor of the gage. Some types of air gaging equipment cannot do this automatically without considerable complication because resetting zero involves several mutually dependent adjustments. For practical purposes, each increment of correction made during the course of operation should be the same.

In a typical application, the wheel of a grinder is retracted at the command of the in-process gage as soon as the part has been ground to finish size, *Fig.* 4. As the work passes from the machine, the second or post-process gage inspects each part and sorts it into a particular size category. After a certain preset number of parts have been found to exceed marginal limits set up within the tolerance extremes, the post-process gage signals the in-process gage to reset its zero point. This is done automatically so that the next piece made will be larger or smaller by an amount equal to the increment of correction. In this way workpiece size is maintained within tolerance over long periods of time despite what may be a considerable drift in the machine due to the effects of heat, wear and other causes.

The combination gaging control system provides close control over both random variation and drift so that effective control can be realized over long periods of time. Most importantly, the machine controlled by combined gages, in contrast to those served by post-process gaging only, has no part in the corrective process. Consequently the machine need only be equipped to produce work until signalled to stop, since it does not have to respond directly to corrective signals.

STATIC CONTROLS AUTOMATE MOLDING

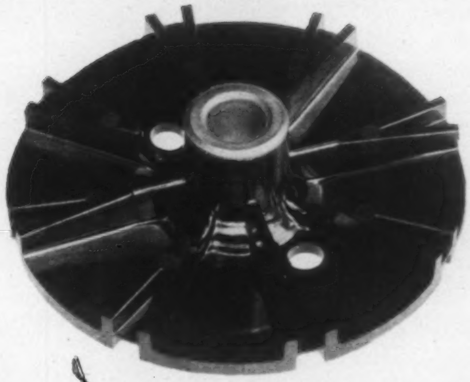


Fig. 1—This 4¾-inch diameter water pump impeller is molded on a 450-ton press in a 12 cavity mold. The impeller is a phenolic plastic. Each impeller requires loading of an insert before molding.

The future holds great possibilities for production of parts through various casting and molding operations if economical means are available. This article describes a high-production automatic press development in which the hydraulically actuated press is controlled by a static switching system.

POSSIBILITIES for increased automation may be presented by a number of different approaches such as improved manufacturing process, improved handling, improved part design, or a change in part material. The latter has been the vehicle for an automation centered improvement in the production of water pump impellers, *Fig.* 1, at Ford Motor Co. A change from cast iron to phenolic plastic has resulted in reduction of part cost and part weight through automatic molding with 450-ton compression molding presses built by Baker Bros. Inc.

A battery of four of these large automatic presses produces Ford's entire requirement of water pump impellers. The new presses perform all the known functions in automatic molding. One of the presses is shown with integrated, attached units in *Fig.* 2. It is adjustable as to time and duration of function. Complete flexibility of cycles incorporating automatic breathe, deceleration at any point in the pressing stroke, and slow breakaway at high pressure were features designed into this press. It has a closure speed ranging from 10.6 to 400 inches per minute and meets all J.I.C. specifications electrically and hydraulically. The press has independent upper and lower hydraulic ejection. To provide the variety of cycles necessary for automatic molding, cycle changes can be made by adjusting cams on control rods.

Electrical controls furnished as original equipment are Westinghouse Cypak controls and provide direction for feeding, ejection, flash cleanout, degassing and deceleration. The static switching design reduces the number of moving parts and thus increases life and reliability. Ford's presses are reported to be the first use of Cypak controls in plastic press panels, *Fig.* 3. A hydraulic and electric layout for the press is shown in *Fig.* 4.

A special safety device is a control which prevents mold damage in event of ejection failure. The ram descends at low pressure until it reaches a limit switch, at which point high pressure is applied. If an obstacle is in the path of the ram it will not trip the limit switch but will stop automatically. An emergency button is also provided which will return the press to top of stroke from any point in the cycle.

Another innovation in plastic molding presses of this tonnage is incorporation of dielectric powder preheating with an automatic loading board. This provides much faster cycles, and of course, additional cost reduction by increased production.

Operating sequence starts with hand dropping of inserts onto insert pins in the mold. Then the high

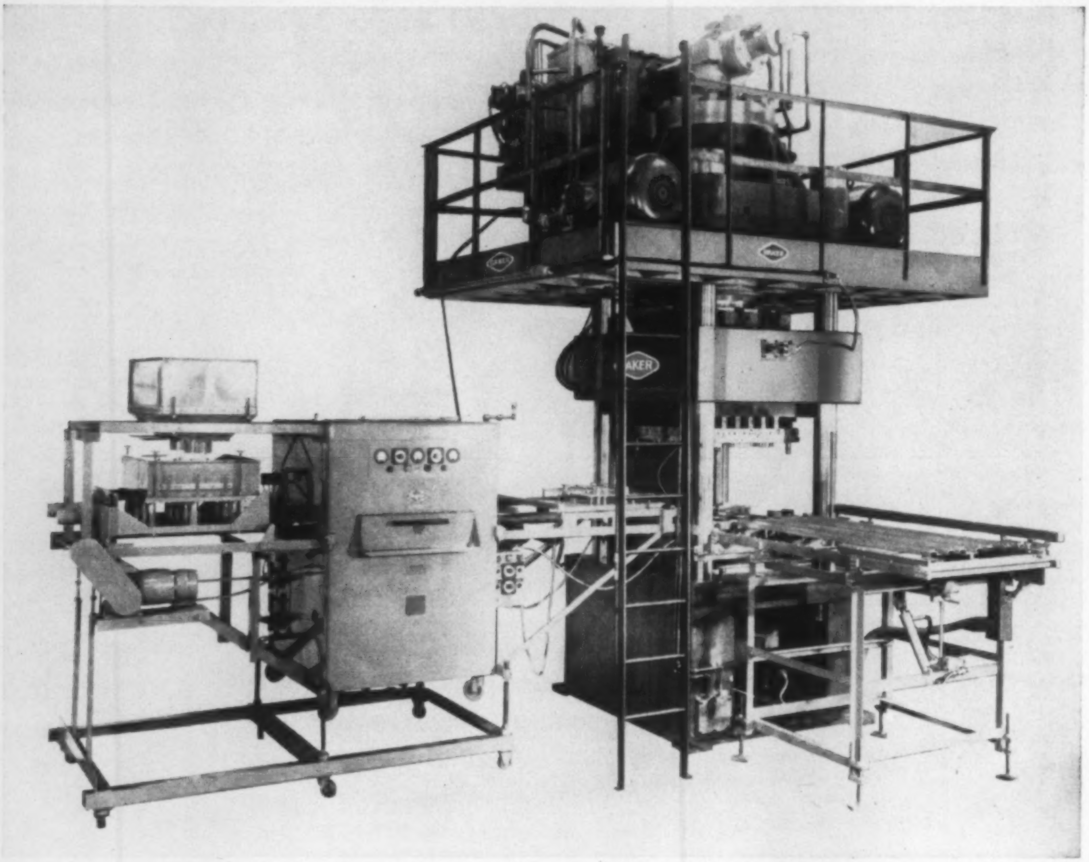


Fig. 2—Baker compression molding press shown with preheater and loading board on the left and ejector at the front. Press molds 12 impellers per stroke on a platen area 36 by 42 inches. Overhead arrangement of hydraulic system permits access to the press and room for accessories.

frequency preheater loader board extends, drops the preheated powder and retracts. Press closes and opens momentarily for breathing (to allow the escape of gases from the mold cavity). After breathing, the press closes for the required cure time, then opens. Bottom ejection occurs, holding the parts on ejector pins. The comb extends, picks up parts, retracts, and drops parts.

There are several design thoughts incorporated in these presses. Motors, pumps and valves are all easily accessible and the hydraulic reservoir or sump has a thermostatically controlled, water cooling system. Specially designed, drilled, steel-block, valve manifolds reduce piping, and valving is gasket mounted for ease of maintenance and minimum leakage.

Baker engineers are confident that the automotive industry will continually be increasing use of plastics, not merely as a substitute but for definite cost reduction. Automated presses are the key to greater economies in plastics, allowing broader usage of these materials in mass production industries.

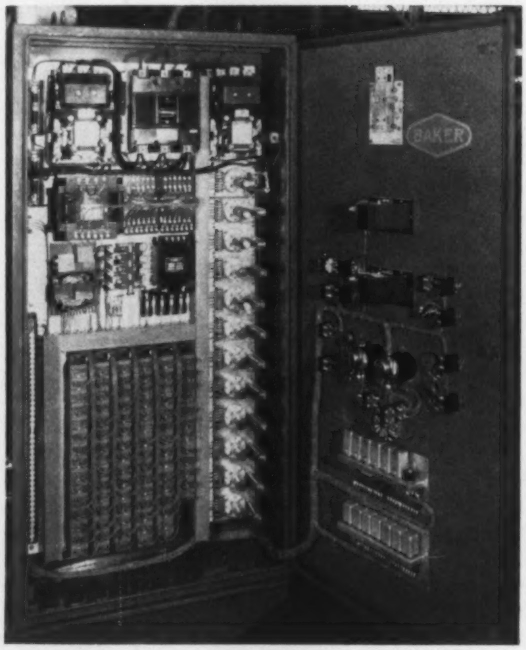


Fig. 3—Control panel showing Westinghouse Cypak units used for the first time in plastic press control. Although the press panel is quite complicated in order to provide flexibility in cycling, changes can be made by adjusting limit switch trips on the ram.

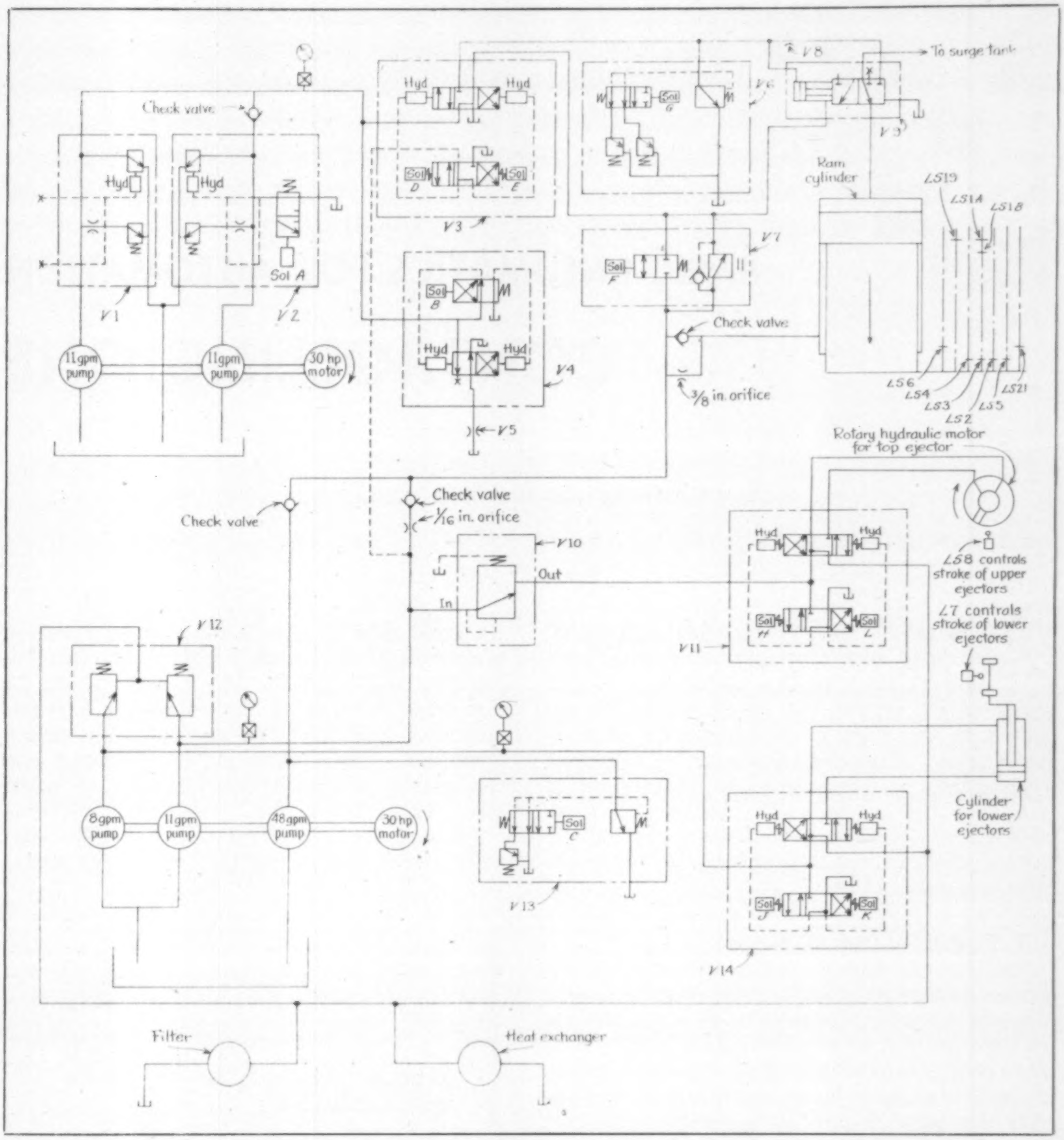

Check valve
Hyd
Hyd
Sol A
V1
V2
11gpm pump
11gpm pump
30 hp motor
Hyd
Hyd
Sol D
Sol E
V3
Sol B
Hyd
Hyd
V4
V5
V6
Sol G
V8
To surge tank
V9
Ram cylinder
V7
Sol F
Check valve
3/8 in. orifice
LS19
LS1A
LS1B
LS6
LS4
LS3
LS2
LS5
LS21
Rotary hydraulic motor for top ejector
Check valve
Check valve
1/16 in. orifice
V10
Out
In
Hyd
Hyd
Sol H
Sol L
V11
LS8 controls stroke of upper ejectors
L7 controls stroke of lower ejectors
V12
8gpm pump
11gpm pump
48gpm pump
30 hp motor
Sol C
V13
Hyd
Hyd
Sol J
Sol K
V14
Cylinder for lower ejectors
Filter
Heat exchanger

Fig. 4—Hydraulic and electrical layout for 450-ton plastic press. To rapid traverse down, *Sol. F* is energized which permits oil flow from the rod end of the cylinder through the ⅜-inch orifice, through *V7*, and finally through *V3* to the sump. The ram will rapid traverse downward until *LS 2* is tripped which will release *Sol. F* and cause the ram to decelerate by venting the rod-end oil across the relief valve in *V7*. At the same time *Sol. A* is energized to pick up the vented 11 gpm pump section, and *Sol. D* is energized to direct oil flow first to the piston of *V9*, to close it at the combined pump volume rate of 22 gpm, and then to the top of the ram cylinder at the rate of flow determined by *V8*. The ram will continue downward at low pressure until LS *4* is tripped, which will energize *Sol. G* and allow high pressure to be applied. High pressure pressing speed will continue until *LS 3* is tripped, at which point, depending on the cycle selected, the ram will either clamp closed or, in a breathe cycle, *LS 3* will de-energize *Sol. D* and the ram will stop for the breathe period. At the end of this breathe time, *Sol. E* and *Sol. A* will be energized, causing the ram to rise until *LS 5* is tripped. The ram can be delayed here by the tarry timer, or immediately reversed by energizing *Sol. D, Sol. A*, and *Sol. G*. The ram will then move downward and clamp, tripping *LS 3* again, which in this instance will initiate the cure period. After the cure timer expires, the decompression timer will be energized and *Sol. D* will be dropped. Compressed oil in the ram cylinder will be vented to the sump through two grooves ground in the spool of *V3*. After the decompression timer has expired, *Sol. E* and *Sol. B* are energized to raise the ram at a slow speed determined by *V5*. When the upward motion of the ram trips *LS 21, Sol. B* is de-energized and *Sol.* C is energized, connecting the 48 gpm pump to the rod end of the ram cylinder and causing the ram to rise at high speed. When *LS 1B* is tripped, *Sol.* C is released decelerating ram speed. When *LS 1A* is tripped, the ram has completed its cycle and the tripping of *LS* 19 cycles the ejectors.

Part 2

BASIC PNEUMATICS FOR AUTOMATION

CONTROLLING ONE

By H. L. STEWART and J. M. MORITZ, Logansport, Ind.

DESIGNERS OF AUTOMATIC MACHINERY are faced with providing many movements automatically. In this second article of a series we will describe how pneumatics can be employed to advantage in providing some of these movements. A word of caution before discussing combinations of movements—the designer should remember not to overload a pneumatic system with unnecessary valves. As always, keep the system as simple as possible and obtain better results with less maintenance.

Controlled Step Movement

One double-acting cylinder can provide several movements, and can be made to do so in a number of ways. In *Fig.* 9, the problem is to quickly move from point *x* to point *y*, pick up object *A* and move it back to point *x* in controlled steps. Such an operation might be applied to moving workpieces successively under polishing and brushing heads of a machine.

In this operation, the workpiece momentarily trips a limit switch *LS*-1 as it is positioned mechanically and the coil of solenoid pilot valve *D* is energized, shifting spool of valve. Air flows to end of spool of pilot operated valve *H*, shifting spool allowing air to flow unrestricted through the free flow section of cam operated flow control valve *K*, on to blind end of cylinder *G* and air pressure forces piston to move forward rapidly. As the piston approaches the end of the outstroke, cam on table slide contacts limit switch *LS*-2 and the coil of valve *C* is momentarily energized and air flows to end of spool of valve *H*, shifts spool to original position and air flows to rod end of cylinder. The end of the table slide latches the pallet carrying the workpiece. The workpiece starts to move from point *Y* toward point *X*. It moves rapidly until cam depresses roller on valve *K*, then the valve shuts off and the speed of the movement is determined by the setting of the orifice. The polishing heads perform their operation, then the cam drops off the roller, and the speed is increased until the second cam depresses the roller, then it slows down again. This process continues until the brushing and polishing is completed and workpiece reaches *X* where it is passed onto a conveyor.

The proper placing of flow controls is essential. Often circuit failures can be attributed to placing

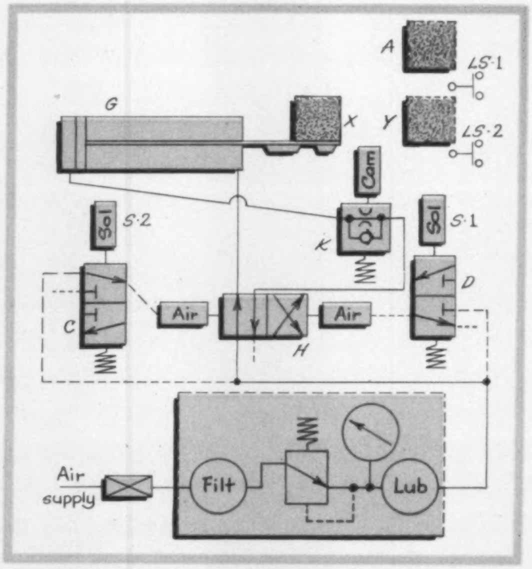


Fig. 9—Pneumatic circuit in which piston moves rapidly to extended position, and is retracted in controlled steps. Cam actuated flow control valve combined with check valve provides free flow in one direction and alternately free and restricted flow in opposite direction.

Methods of selective deceleration of piston motion and arrangements for oscillation of machine elements are explained in this second part of a series.

DOUBLE-ACTING CYLINDER

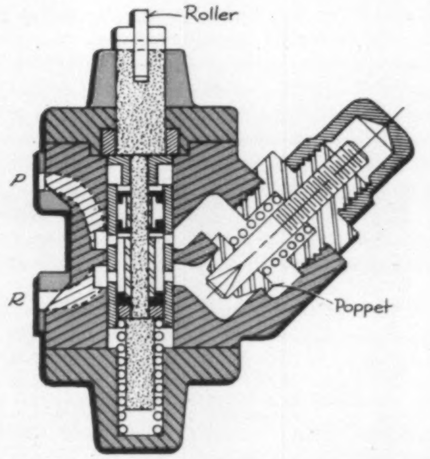


Fig. 10—Cam actuated flow control valve applicable to Fig. 9. With roller in *Up* position shown, air may flow freely between *P* and *R* in either direction. With roller in *Down* position, center seal on spool cuts off passage except through poppet section of valve. Air may flow from *R* to *P* at rate allowed by spring behind poppet, but no air can flow in direction *P* to *R*.

the flow controls at the wrong place in a circuit. Nearly all air flow controls are designed for exhaust metering, which means that the air which is exhausted from a cylinder or valve is to be metered. Cam operated control valves are a combination of a flow control and a shutoff valve built into one body, *Fig.* 10. It is important that the check valve in the flow control unit seats tightly and the shutoff valve closes off completely. Synthetic seals are used in the shutoff section of the valve shown. It is important that dirt be kept out of these valves as it can lodge in the seat of the check valve and make the valve ineffective. Remember, air can leak out of a very small crack or hole.

Another way to obtain the skip-feed as required in *Fig.* 9, is to use a limit switch and a solenoid operated shutoff valve in conjunction with the flow control valve (instead of direct cam actuation). This makes a compact arrangement and little effort is required to trip the limit switch.

▶ Two-Direction Control

In *Fig.* 11 the problem is to control speed of a piston in both directions. There are several ways of doing this, however, the method shown is usually preferred. In this application our problem is to move drill head *A* from point *X* to *Y* under a controlled feed while work is being performed, then return under controlled speed for a tie-in with a time cycle. The circuit functions like this: The index table positioning momentarily actuates pilot valve *C*, which bleeds the air from port *U* of pilot operated four-way control valve *H* and spool in valve *H* shifts allowing air to flow through check portion of valve *K* on to tail end of cylinder *S*. As the piston moves forward the speed is controlled by the exhaust air in the rod end of the cylinder passing through the orifice in flow control valve *L*. As piston reaches end of its stroke, cam on tailrod of piston trips cam operated valve *D*, bleeding air pressure from port *V* of valve *H*. Spool shifts and air can now flow to rod end of drill cylinder through valve *L*. The speed of the retracting stroke is controlled by orifice in valve *K*. There can be quite a difference in piston speed from that on the outstroke and that on the instroke, or it can be the same. Often requirements call for a very slow outstroke and a little faster instroke or vice versa.

To save the use of one flow control valve a different arrangement is considered. Here the valves *L* and *K* are removed and the flow control is attached to the exhaust line leading from the four-way valve in *H*. This scheme has a couple of loopholes. In the first place when using one flow control valve to control both directions of piston movement, it is necessary to use about the same speed in both directions. The only difference in speed is created by the displacement volume of the piston rod and whether there might be a dif-

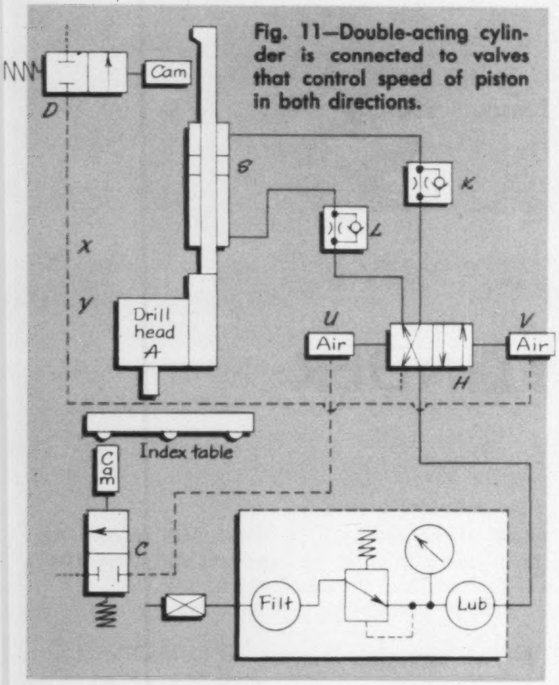


Fig. 11—Double-acting cylinder is connected to valves that control speed of piston in both directions.

ference in loading in one direction. The second loophole is that back pressure in some valves will cause the spool to become inoperative due to seal friction. This friction may overcome the operating force, especially if solenoids are the actuating means. The designer in this case should be cautious of eliminating a valve, which costs only a few dollars.

▶ Timed Period Oscillation

Automatic movement in two directions for a given time or a given number of cycles is often desired. *Fig.* 12 is a good example of how to solve this problem. The dipping cylinder is normally in retracted or loading position. Material *A* is loaded into the basket at point *X*. Operator depresses pushbutton, which momentarily energizes coil of two-way valve *C* bleeding air from pilot *U* of four-way pilot operated valve *H*, shifting valve spool and air flows to blind end of dipping cylinder *S* and piston starts to descend. At the same time the depressing of the pushbutton energizes coil of valve *D* and it is kept energized by a holding relay and a timer. Cam on piston rod rides over cam roller of two way valve *E* and basket is submerged in wash tank. Cam contacts roller on two way valve *F* bleeding line from pilot *V* of valve *H* and spool shifts to position directing air to rod end of cylinder. Piston begins to retract. When cam depresses roller of valve *E*, air is bled from pilot *U* of valve *H*, shifting spool directing air to blind end of cylinder. This process continues until timer runs out de-energizing coil of valve *D*. Then when piston starts on its upstroke it will continue until it reaches the end of the upstroke since action of valve *E* is ineffective with valve *D* closed. Cycle stops and basket can be unloaded.

▶ Oil Cushioned Action

A number of similar circuits can be worked out with pneumatic equipment. There are applications in which the workpiece must be handled very carefully. Such items as glass tubing or other glass products, pottery, sand cores, and ceramic pieces must be traversed carefully. In *Fig.* 13 is a circuit where a tray of parts to be baked is put into a furnace. The circuit works like this: Tray of parts is moved onto transfer table and cam operated two-way pilot valve *C* is actuated, which bleeds air from port *U* of pilot operated valve *H* shifting spool of valve and directs air to blind end of air-hydraulic cylinder *S*. When piston is in the retracted position a cam on transfer mechanism keeps decelerating-valve roller depressed which restricts oil flow. As piston starts forward the oil is metered through the adjustable orifice at a very slow rate, then the decelerating valve spool starts to rise allowing more oil to flow through it. When the spool is completely raised the full flow of oil passes through the valve and the piston of the cylinder reaches its maximum speed. As the piston approaches the latter part of its travel a cam starts to depress the roller on the decelerating valve *E* and by the time the tray reaches the end of the travel the valve roller is

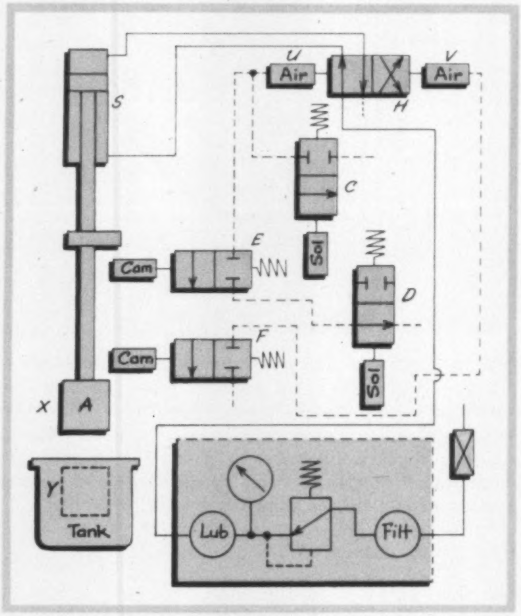


Fig. 12—Circuit causes piston to oscillate up and down until timer allows solenoid actuated valve D to close, thereby initiating termination of cycle.

completely depressed and deceleration has taken place placing the tray in the furnace without any jar. As the tray reaches end of travel the trip on two-way valve *D* is contacted momentarily, bleeding pressure from pilot *V* of valve *H* and the spool is shifted, directing air to center of air-hydraulic cylinder and piston rapidly retracts to starting position as the ball check is unseated. This completes the cycle. The success of the operation of the deceleration valve depends upon the design of the cam which depresses the roller of this valve. The climb on the cam should be gradual so as to obtain a straight line acceleration and deceleration. The starting speed can be changed by making an adjustment of the orifice control. The operating pressure of the system is controlled by the setting of the pressure regulating valve.

▶ Continuous Oscillation

Carrying the idea in *Fig.* 13 a little further, *Fig.* 14 shows a circuit that can be used for many applications. It not only can be used in an automated line, but is adapted for operations where the workpiece is manually loaded. For instance, in the operation of a worktable one does not want it to bang at the ends of its travel. In this circuit deceleration and acceleration take place at each end of the stroke. The operator loads the workpiece onto the machine table and momentarily shifts the handle of a four-way, three-position ball-detent pilot valve *C* to position directing air pressure to shuttle valve *B*, shifting its spool and directing air pressure to pilot port *W* of valve *G*. Spool of valve *G* shifts, directing air to blind end of air-hydraulic cylinder *S*. Operator then shifts the handle as far as he can in the opposite direction. Piston moves at a rate set by orifice *V* and orifice through cam operated deceleration valve *F*. The piston moves rapidly until cam roller of valve *F* is depressed by cam on worktable. This happens at the same time a cam rides over trip on three-way pilot valve *D*. Speed of piston is increased as roller of deceleration valve *F* is released. As piston nears end of stroke cam roller of deceleration valve is again depressed slowing piston movement. Cam on table trips mechanism on three-way valve *E* directing air flow to pilot *Z* of valve *G*, shifting spool. Piston starts to retract slowly until roller of valve *F* rides off cam then the piston speeds up. When the piston nears the end of stroke cam depresses roller of deceleration valve *F* and piston movement begins to slow-up. When cam trips mechanism on valve *D* air is directed through shuttle valve to pilot *W* of valve *G*. This again shifts valve spool and directs air to blind end of cylinder. Cylinder will reciprocate until operator shifts handle of valve *C* to neutral position. If at that time piston is out it will finish the cycle and stop. If it is retracting it will move on back and stop.

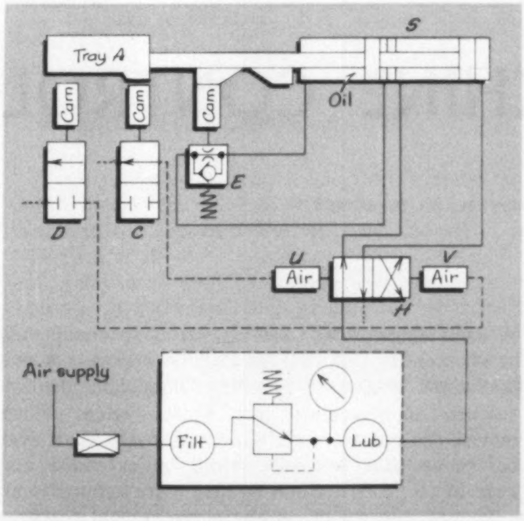


Fig. 13—Combination air-hydraulic cylinder uses cam operated deceleration valve on closed hydraulic circuit to control speed at ends of piston's forward stroke.

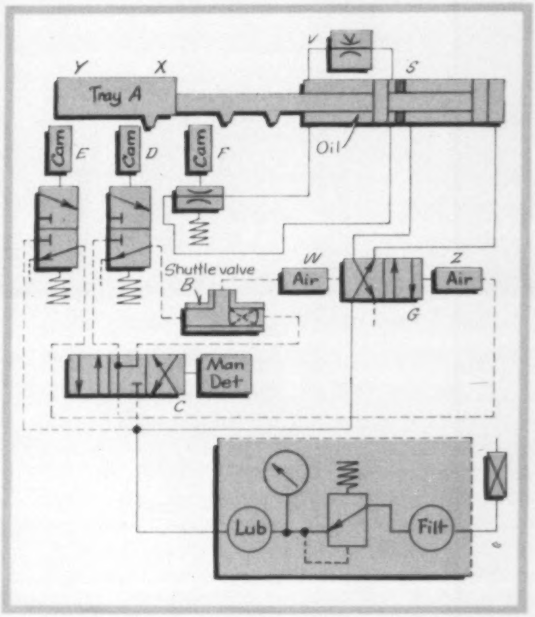


Fig. 14—Circuit similar to that of *Fig.* 13 is arranged to oscillate the piston back and forth until cycle is manually terminated. Three-position, four-way, manually operated valve and a shuttle valve make this possible.

If a different speed is desired in both directions two different flow control valves can be used so that the oil will be subjected to one orifice in one direction of flow and to the other one in the other direction of flow.

Innumerable circuits can be worked out using a single means of movement such as an air cylinder or air motor to do a particular job. As we progress in this series we will group some of these single movements and show what can be accomplished with such groups.

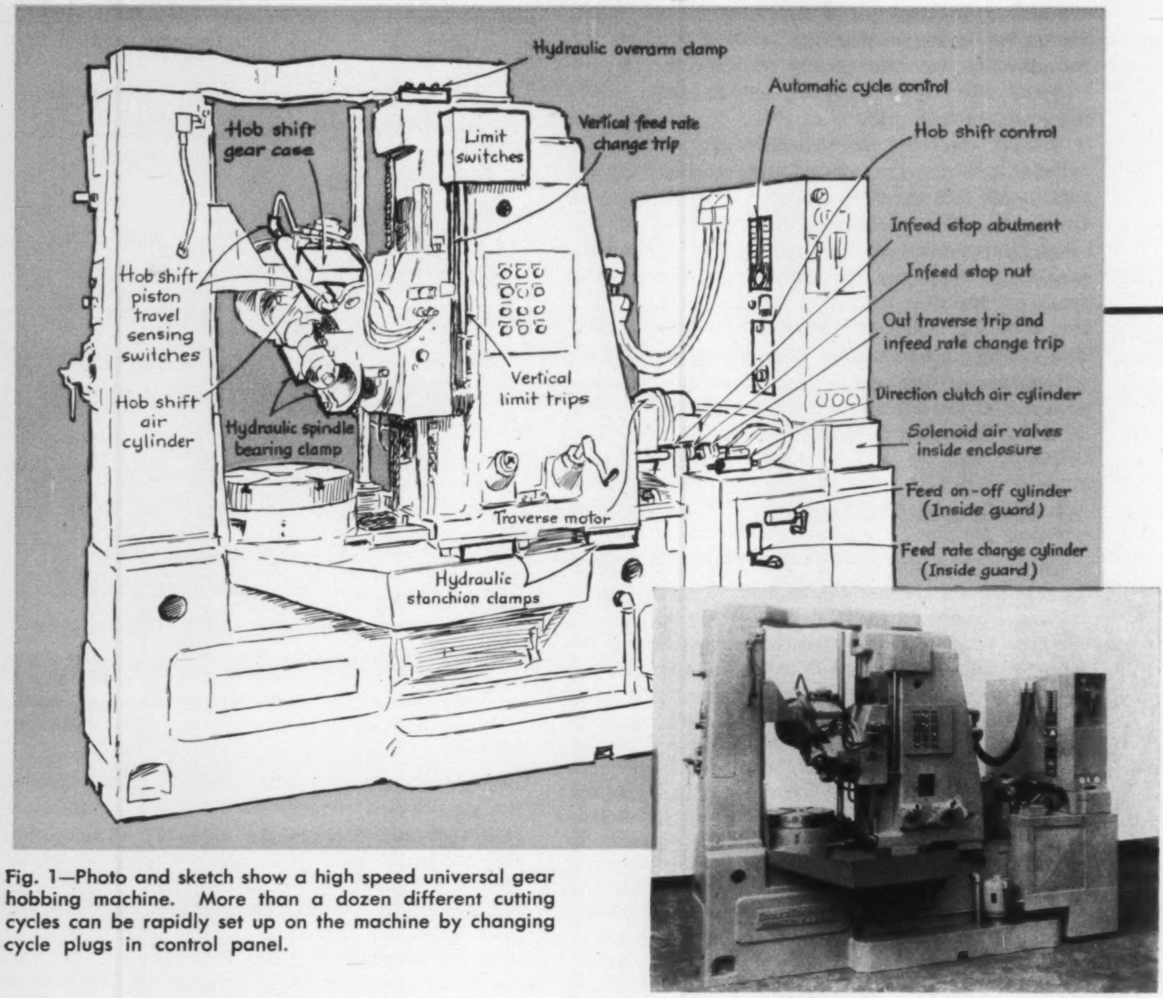

Hydraulic overarm clamp
Automatic cycle control
Hob shift gear case
Limit switches
Vertical feed rate change trip
Hob shift control
Infeed stop abutment
Infeed stop nut
Hob shift piston travel sensing switches
Out traverse trip and infeed rate change trip
Vertical limit trips
Direction clutch air cylinder
Hob shift air cylinder
Hydraulic spindle bearing clamp
Solenoid air valves inside enclosure
Feed on-off cylinder (Inside guard)
Traverse motor
Feed rate change cylinder (Inside guard)
Hydraulic stanchion clamps

Fig. 1—Photo and sketch show a high speed universal gear hobbing machine. More than a dozen different cutting cycles can be rapidly set up on the machine by changing cycle plugs in control panel.

PLUG-INS PROVIDE

VERSATILE MACHINE CONTROL

By **E. W. SMITH**, President, Sensory Inc., New Vernon, N. J.

VERSATILE CONTROLS are required to effectively use a versatile machine. Gould & Eberhardt Inc. was recently faced with the problem of providing such controls for a universal gear hobbing machine. Their machine could cut spur, helical, herringbone or worm gears with only minor setup changes. They had designed into their machine many mechanical features which allowed it to cut gears faster then ever before; they had broken the cutting cycle into a chain of smaller elements to permit optimizing the speeds and feeds of each element so that overall cycle time could be shortened; and they had added elements which facilitated workpiece handling. They had also developed an automatic hob shift system which moved the cutter much more uniformly than ever before so that hob life would be extended and gear tooth profiles could be held more symmetrical.

Manual control of all these mechanical features was impractical; so an automatic control was essential. The complexity of the control problem was increased by the ability of the machine to

To be economically justifiable many machines must be able to perform different operating cycles for a variety of workpieces. Such versatility may often make automatic cycle controls seem impractical, but the universal gear hobbing machine described in this article is provided with easily changed automatic cycles through use of interchangeable program plugs.

---

cut so many different types of gears and by the fact that different methods of cutting were required for materials ranging from laminated plastics to heat treated steel. In all, there were fourteen different sequences of operations required to provide desired automatic cycles plus hob shift. In addition it was necessary to provide full manual control for setting up and for short-run jobs.

It was decided to try a control based on communication type relays and to employ the services of an outside group experienced in that type of circuitry. Sensory Inc. was called upon, and in the consultations that followed it was brought out that ease of electrical maintenance was an important factor. Experience with previous automatic controls had shown that as complexity grew even specification of the most reliable components was not enough to eliminate trouble, and that when trouble did develop in an automatic control it was usually so well hidden in the mass of components that trouble tracing became a tedious job. As a consequence, the controls were designed as plug-in packages both for ease in initial installation and for subsequent maintenance and repair. Two separate packages were developed; one package made up the cutting cycle control; and the other made up the hob shift control. Each can be used separately or in combination with the other.

▶ Cutting Cycle Control

The cutting cycle control has its telephone type relays operated on 115 volts dc to obtain the many advantages to be derived from the use of dc. The first of these is that a slow-operating slugged-coil relay and a quick-acting relay can be combined with *Start* and *Stop* pushbutton switches to form a safe-start network. This network is used as a master control for all four of the motors and for the automatic cycle sequencing system. The pushbuttons perform their usual functions and also, as an additional feature derived from the use of dc relays, simultaneous operation of the *Start* and *Stop* pushbuttons permits the machine automatic cycle to be started but keeps each cycle step directly under the operator's control rather than have cycle stepping occur automatically. This allows an operator to check all the mechanical and electrical operations and to make adjustments. This same safe-start network is also a safeguard against machine operation being initiated by the accidental operation of limit switches,

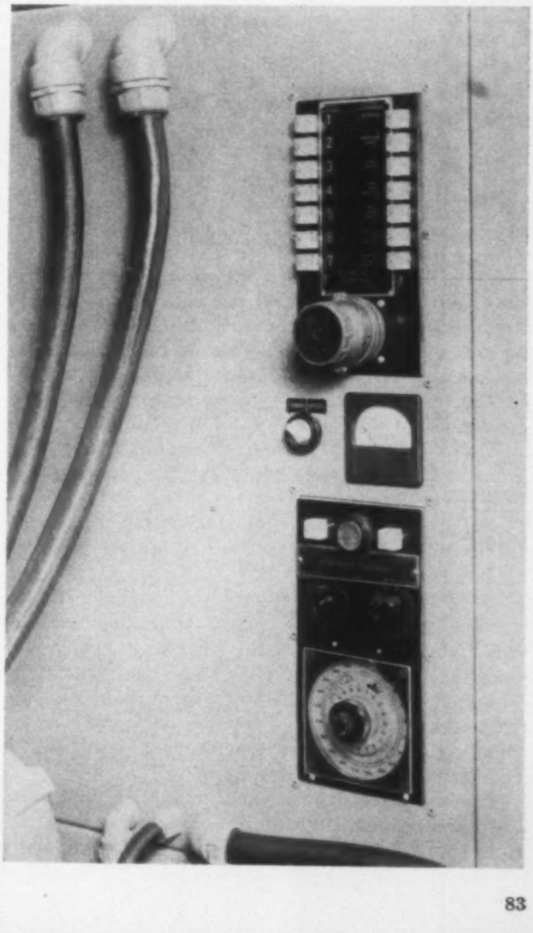


Fig. 2—Closeup of control panel shows plug for a specific cycle in place in cutting cycle control package at top of panel. Hob shift control package is at bottom of panel. Both control packages are designed to be easily replaced as complete units.

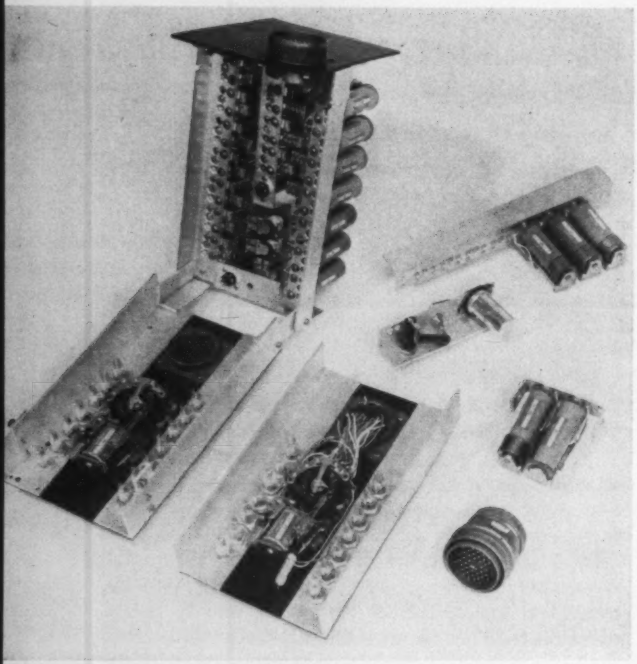


Fig. 3—Photo of cycle control package, partly assembled, also shows some of the telephone type relays used, a cycle plug, and the hinged construction of the chassis.

such as might occur while setting up. Sequencing of all automatic cycles is accomplished by an Automatic Electric Type 44 stepping switch. This switch is stepped by pulses formed by a battery of slow-operating slugged-coil relays which have their coils energized by limit switches that sense the completion of each phase of the cutting cycle. Other pulses are formed by self-pulsing features of time delay relays and other control elements.

Since at least fourteen different cycles must be obtained from one control package, cycle selection is injected into the operation of the stepping switch by programming. This is accomplished by connecting the stepping switch contacts to half of the terminal points on a connector socket, connecting the relay coils of all the function relays to the other half of the terminal points, and using a connector plug together with appropriate jumpers as a program selecting device. Any of the fourteen different cycles may be obtained by merely inserting the plug for a desired program into the socket.

Machine functions are directly controlled by the various motor starters and by solenoid valves for the hydraulic and pneumatic cylinders which perform the clutch shifting and clamping functions. The motor starters and solenoid valves are controlled by the function relays, and the various function relays are switched in and out in the required sequence by the stepping switch.

The control circuit is amply supplied with sensing switches which feed back operating information to the control. If any function commanded electrically is not performed mechanically, the machine either shuts itself off or disconnects the feed. It then indicates the malfunctioning member by lighting a neon indicator light on the control panel. This simplifies mechanical troubleshooting and reduces downtime to a minimum.

The cutting cycle control chassis is a compact package measuring only 11 by 6 by 6 inches and is furnished as a plug-in unit. This is feasible since the very versatility of the cycle selection method makes it improbable that a circuit change will be required to suit a given set of requirements. In fact, two cutting cycles that had not originally been contemplated have already been added to the machine's repertoire. Since the circuit design is stable, the controls can be built in quantity and, in the event of an electrical failure, the intent is that the control chassis be exchanged as a unit rather than require an on-the-spot repair. While very little trouble has developed in the field, it has been found that such a plan for exchange-replacement has been advantageous.

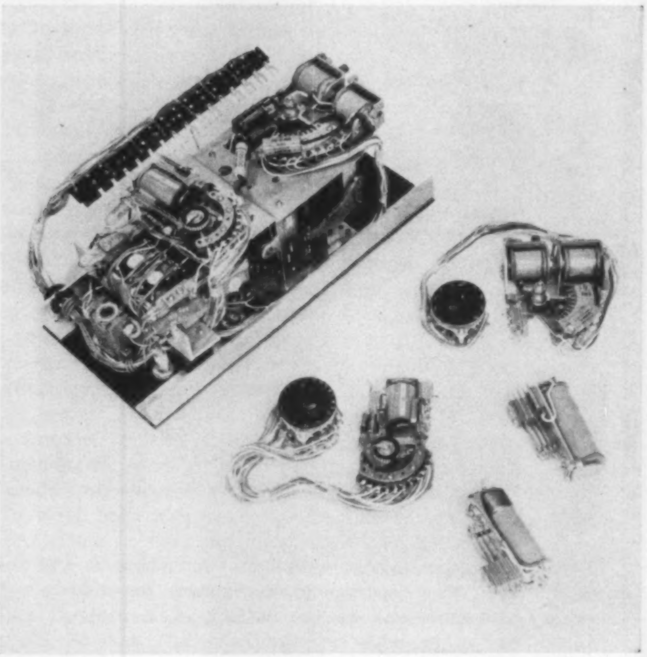


Fig. 4—Assembly photo of hob shift control package and some of its components illustrates the compact mounting possible with such telephone type units. The package can be rapidly connected to electrical circuits in the machine through the terminal strip.

Still another advantage is obtained from the unit packaging of the controls. All of the machines must conform to either or both National Machine Tool Builders' Association or Joint Industry Conference electrical codes. By having the control package replaceable as a unit and having replacement packages available, compliance with these codes is possible, even though some of the internal features of the control chassis do not comply. Specifically, both codes prohibit the use of solder in making terminations. It was not possible, though, to avoid the use of solder at the neon lights and at the rectifier. However, the wire used is of the type and size specified in the codes and all of the telephone type relays and stepping switches have their connections made by solderless taper-tab connectors.

Even though on-the-spot repair of the control is not contemplated, the structural design of the control is such that a hinged two-deck frame assembly makes all of the connections easily accessible for checking. The control is also furnished with its own cover. These deviations from standard communications practices were made to enable near-compliance with the machine tool codes and have resulted in a highly reliable long-lived control.

▶ Hob Shift Control

Gear tooth symmetry is controlled to a large extent by the accurate centralization of a cutting hob tooth. When a hob is initially set up on the machine for cutting, one of its teeth is adjusted to be central with the gear. As the hob wears, it is shifted axially to bring unworn teeth into working position, and it is important that the shift be made accurately so that the new tooth will be automatically centered. The hob shift mechanism to accomplish this includes an air cylinder, a rack, a ratchet, change gears, and a gear assembly which shifts the hob an accurate, preset distance with each stroke of the air cylinder. Any small errors in the accuracy of each shift are not cumulative, so accurate centralization is preserved for the full life of the hob. The air cylinder which actuates the hob shift includes two limit switches which detect completion of the movement of the piston in either direction.

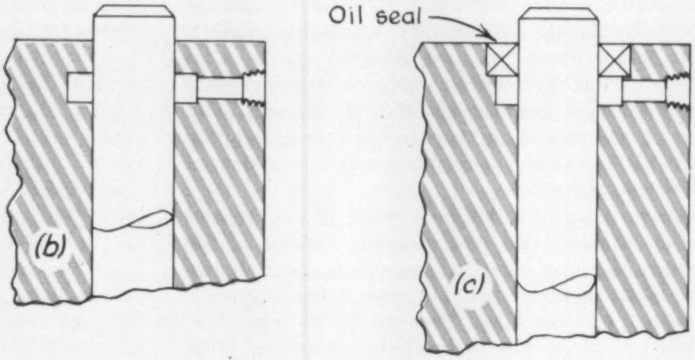
The hob shift control is a separate package, and may be used even on machines which do not have automatic cutting cycle control. It includes predetermining counters and relays which control the hob clamping and unclamping and the movement of the hob shift air cylinder. One predetermining counter is synthesized out of a selector switch and a stepping switch and counts the number of cutting cycles that the machine has completed since the last shift. When the counter reaches its preset number, it initiates the shift. When the shift is started, control relays first energize a hydraulic solenoid valve which removes the 1500 psi clamping pressure from the hob spindle bearing and then cause a second solenoid valve to stroke the shift cylinder.

A second predetermining counter which is also synthesized out of a selector switch and a stepping switch then takes over control. Mechanically, the maximum shift possible per stroke is 0.080 inch. For all shifts over 0.080 inch and even for some odd shifts below 0.080 inch, it is necessary to resort to multiple stroking. This second counter, called the shift multiplier, is preset to the desired number of strokes and keeps the cylinder stroking until the required number of strokes have been made. All this takes place very quickly, an 0.800-inch shift taking only about 5 seconds—so fast that during the last step of an automatic cycle it is rarely detected as having even occurred. When the shift has been completed, the counters are cleared and the hob spindle bearing is automatically clamped. If hydraulic clamping pressure is accidentally lost, a pressure switch stops the machine.

The hob shift control, like the cutting cycle control, is a compact plug-in package measuring only 12 by 6 by 5 inches. The use of such small packages has effected substantial savings in many ways. The packages themselves are less expensive than those using standard relays; electricians' time is reduced; smaller enclosures are possible; and field service costs are less.

Piler Eliminates Double Handling

A PROBLEM faced by Dawes Silica Mining Co. Inc. was that silica sands had to be handled at least once and sometimes twice by a locomotive crane to get them to a desired piling location. Solution to the problem was the installation of the piler shown. This Swivelpiler was built by Stephens-Adamson Mfg. Co. and handles 140 tons of material per hour. A conveyor belt 18 inches wide carries material to the discharge point 35 feet from the ground. The sand is then thrown as far as 50 feet in any desired direction.



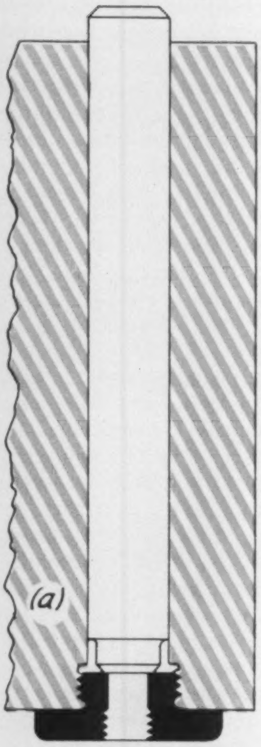
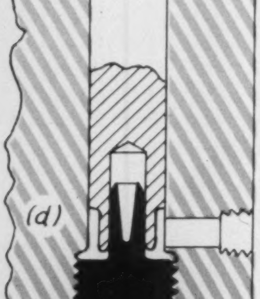


Fig. 1 — Basic plug and bore (a) can be modified to have undercut *(b)* and oil seal *(c)*. At *(d)*, a cushion has been provided to ease final portion of plug return stroke.



HYDRAULIC ACTUATION

Rising demands for special purpose production facilities are creating new challenges for many designers. For example, the complexity of modern multifunction machines often poses space and accessibility problems in the location of actuators. The "Plug in a bore" philosophy here described promises a solution to such problems when the actuation is hydraulic.

By WALTER C. WEBER, Consultant on Special Purpose Equipment, Horseheads, N. Y.

WITH the present accelerated trend toward mechanization and automation of production facilities, there is and will continue to be increasing interest in the development of special purpose machines. This will be especially so as a saturation point is approached in the integration of standard machine tools for parts manufacture, and attention is turned to the relatively neglected field of automatic assembly.

One fact is evident from a perusal of the design trends for special purpose equipment as found in technical periodicals and in the literature of vendors of building block components. That is, hydraulics is in relative disuse as a means of powering such facilities. This is surprising in view of the fact that hydraulics offers a convenient means of supplying power to components that are often difficult and sometimes impossible to reach by other means. The range of standard equipment offered by manufacturers of hydraulic components—metering valves, sequence valves, speed and pressure controls, etc.—is certainly adequate to provide necessary control of cycling, motion, and pressure. In general, these are more easily built into complex equipment than are some other types of controls.

Numerous factors probably account for the apathy toward employment of hydraulics in this service. One strong reason is that even experienced machine designers seem to have had only minor association with its principles. Some cannot visualize hydraulics as a means of positive, controlled motion; others are unduly concerned with the specter of uncontrolled leakage and excessive maintenance of cylinder packings.

There are, of course, situations in which varying packing friction can disturb the smoothness of hydraulic motion. In other cases leakage must be accepted as inevitable. In the words of one old timer, "Let it leak, but take care of it!" By and large, however, normal applications of hydraulics do not call for extreme design precautions or constructional refinements.

▶ Simple Concept

Experience in, and study of, the uses of hydraulics for special purpose equipment will provide the designer with a catalog of the many ways in which this medium can be used to advantage. In effect, they will broaden the scope of his design philosophy. With this end in view, a simple yet effective application of hydraulic actuation that has been used successfully by the author for the past 15 years will be described. It is called, "A plug in a bore."

SIMPLIFIED

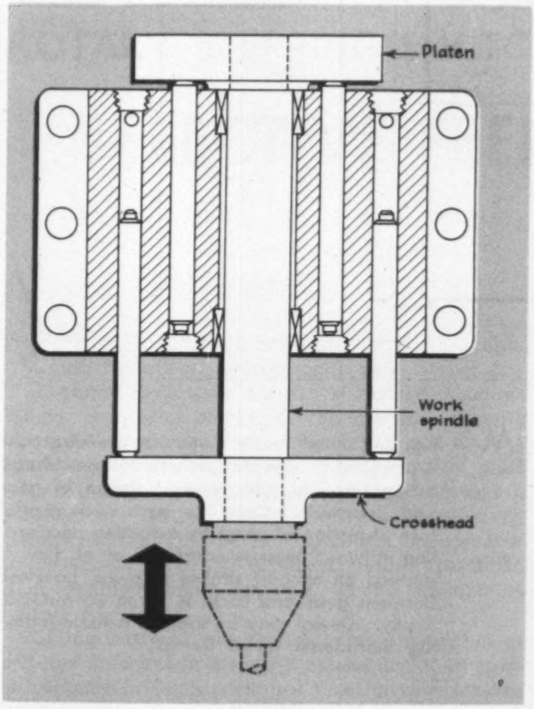


Fig. 2—Double acting plug and bore arrangement to reciprocate a work spindle, which may be rotating. Two inner plugs provide motion in one direction and two outer plugs acting on crosshead effect motion in opposite direction. Fixed base containing bores may be separate unit or part of main machine frame or a subassembly.

This concept is shown in its simplest form in *Fig.* 1(*a*). Using gun drills, smooth, straight bores of any reasonable length can be produced in fairly close-grained cast iron. The plug should be hardened steel ground to a neat slip fit in the bore. When a generous length of plug remains in the bore with the plug in its extended position, leakage will be surprisingly low even with pressures of 500 or 600 psi. The leakage that does occur can be taken care of by designing so that it drains directly to the machine base, which serves as a reservoir.

If space limitations preclude a generous engagement of plug and bore in the extended plug position, or if the unit cannot readily be arranged to drain into the base, an undercut as shown in *Fig.* 1(*b*) can be provided. Leakage can then be piped directly to the reservoir. To protect further against leakage a simple oil seal as shown in *Fig.* 1(*c*) may be used. This is particularly desirable when the plug is to operate downwardly. Various types of cushions may be provided at the opposite end of the bore when required. One design of cushion is shown in *Fig.* 1(*d*).

The forces required by different devices to be actuated, and the hydraulic pressure provided, determine the range of plug sizes that will be needed in a multifunction machine. It is well therefore to establish these parameters early in the planning stage. In this way a practical balance can be achieved that will avoid the specification of ridiculous pressures and/or plug diameters. For a given pressure, the theoretical force obtainable from a given plug is $F = (\pi/4)\ d^2p$ pounds, where d is the diameter of the plug in inches, and p is pressure inside the bore in psi.

▶ Double Action

So far the discussion has concerned applications of the plug and bore in single action. Double action may be provided as shown in *Fig.* 2. In this design a work spindle is fitted with bearings suitable to the service, preloaded bearings being used where extreme accuracy is required. Rotating drills, taps, and turning tools may be used as indicated, or the platen may be used to transport components such as molds, dies, clamping jaws, or linkages for centering devices.

As shown, two inner plugs provide motion in one direction, and two outer plugs acting on a crosshead effect motion in the opposite direction. The fixed base containing the bores may be a separate unit, a part of a subassembly, or integral with the machine frame. The only accurate machining location need be that of the work spindle; locations of the plugs are not critical, since they are not subject to side thrusts. With the automatic lubrication they receive, wear of the plugs is negligible.

A schematic diagram of a device to provide limited rotary motion in two directions is shown in *Fig.* 3. One of its applications is in the driving of an indexing mechanism for a turret. Plugs, acting through racks, rotate a gear and gearshaft. Cams attached to the racks control the rate of motion of the plugs by actuating deceleration valves. Because these valves restrict the flow of exhaust oil, backlash in the gear and the racks is taken up automatically. This assures smooth indexing.

The device of *Fig.* 4 can be employed to provide oscillations of smaller angular displacement than those of the mechanism shown in *Fig.* 3. It is also suitable for right-angle application of force. Here again, motion control may be achieved through use of deceleration valves. An alternative would involve speed control valves for rate of motion, and cushions to ease stopping.

Designers of multifunction production machines for automation will recognize in the "plug in a bore" philosophy a convenient means of providing actuation in locations that are difficult to reach or where space is limited.

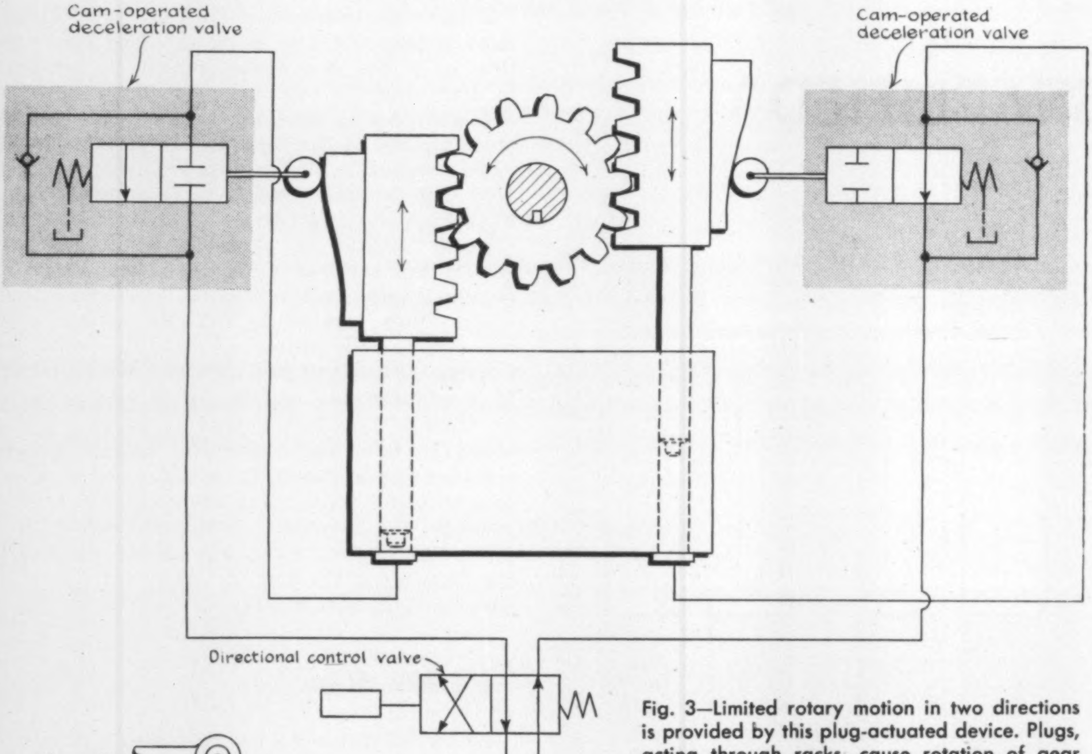

Cam-operated deceleration valve
Cam-operated deceleration valve
Directional control valve
Pressure in

Fig. 3—Limited rotary motion in two directions is provided by this plug-actuated device. Plugs, acting through racks, cause rotation of gear and gearshaft. Cams on each rack control rate of motion of plugs by actuating deceleration valves. Because restriction of oil flow is applied on exhaust strokes of plugs, backlash between gear and racks is taken up automatically. Device may be used to actuate indexing mechanism for a turret.

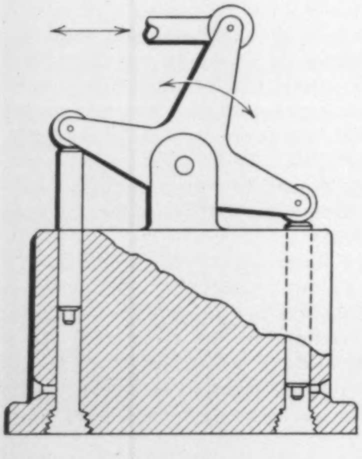


Fig. 4—Oscillating arm of this plug and bore device may be used to transmit motion at right angles. Angular displacement is smaller than that for mechanism of *Fig.* 3.

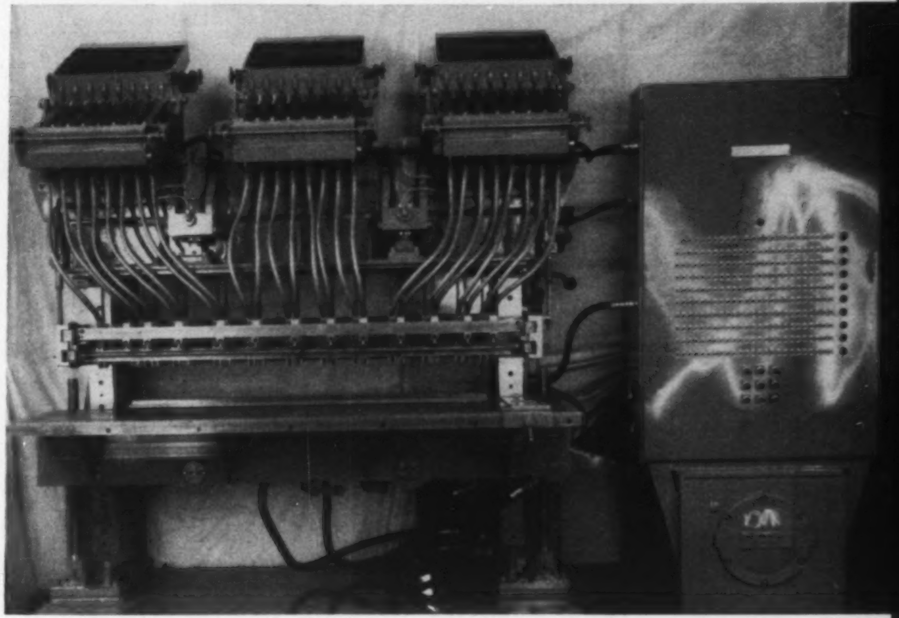


Fig. 1—Automatic nailing machine built by G. M. Diehl Machine Works Inc. Nails are fed from the three hoppers through tubing to individual nail driving heads. Release of nails into tubing is controlled by solenoids in accordance with pattern established by selector switches located on control panel. Two hydraulic cylinders, shown between hoppers, move ram down to drive nails. Cylinders in table can actuate the clincher bar which rises to clinch nails on underside of work.

ROTARY STEPPING SWITCHES SIMPLIFY

SELECTIVE FEEDING CONTROL

FLEXIBILITY of operation is an outstanding feature of an automatic nail driving machine developed by G. M. Diehl Machine Works Inc. The design of the machine permits independent manual positioning of 24 nail driving heads which are selectively supplied with nails automatically through three hopper feeds and a complex of flexible tubing, *Fig.* 1. Supplied by Gemco Electric Co., the control allows the operator to preselect up to 10 different nailing patterns, each capable of using any or all of the available 24 nailing positions.

Nailing patterns are set up by the operation of selector switches in a matrix consisting of 10 rows of switches with 24 switches in each row, located on the front of the control panel. In addition, rows 2 - 10 contain a master switch which can isolate the row from the control circuit. In the *On* position the switches permit the feeding of a nail to the indicated driving position. With a desired pattern established through switch manipulation, the operator loads lumber into the machine and positions it to take the first pattern of nails. Operation of a foot switch activates a hydraulic ram which drives the nails as set up by the first row of switches. At the end of the cycle when the ram again reaches the top end of its travel, the operator manually repositions the lumber to take the second pattern of nails as established by the second row of switches. The controls continue to step from row to row with each descent of the ram until the maximum of 10 rows is reached or until a row is reached in which the master switch has been turned off at the control board. At either of these points, the electrical circuit will then reset back to the first pattern of nails.

Several different circuit designs might have been employed in achieving the cyclic action which has been described. In considering the possibilities, however, it was found that three 10-level rotary stepping switches connected in parallel could be used to accomplish the same function as several relays. (For a discussion of an alternate control design for a similar machine see AUTOMATION,

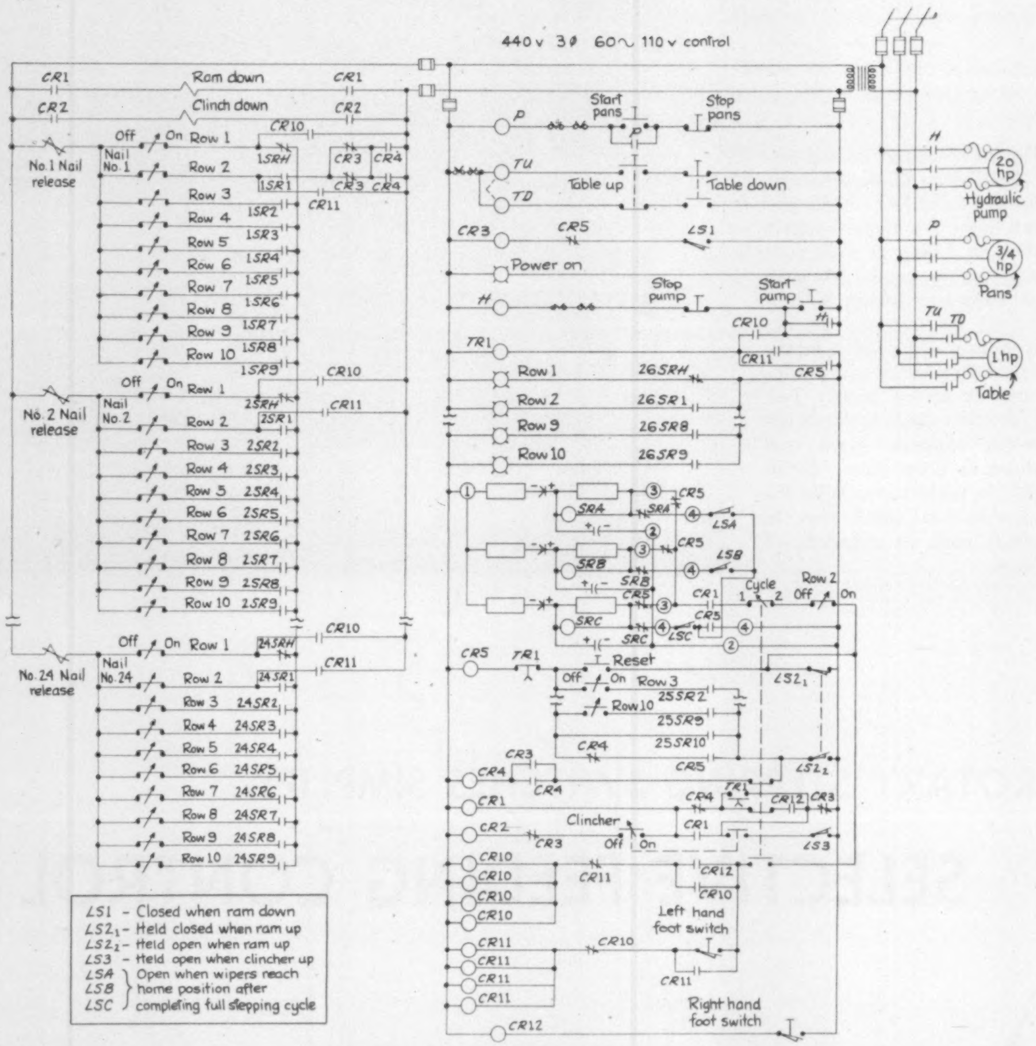

440 v 3ϕ 60~ 110 v control
CR1
Ram down
CR2
Clinch down
No.1 Nail release
No. 2 Nail release
No. 24 Nail release
Nail No. 1
Nail No. 2
Nail No. 24
Off
On
Row 1
Row 2
Row 3
Row 4
Row 5
Row 6
Row 7
Row 8
Row 9
Row 10
CR10
CR11
CR3
CR4
Start pans
Stop pans
Table up
Table down
Power on
Stop pump
Start pump
Hydraulic pump
20 hp
3/4 hp
Pans
1 hp
Table
TU
TD
TR1
CR5
LS1
SRA
SRB
SRC
LSA
LSB
LSC
Cycle
Reset
LS2₁
LS2₂
Clincher
LS3
CR12
Left hand foot switch
Right hand foot switch
LS1 - Closed when ram down
LS2₁ - Held closed when ram up
LS2₂ - Held open when ram up
LS3 - Held open when clincher up
LSA, LSB, LSC - Open when wipers reach home position after completing full stepping cycle

Fig. 2 — Diagram indicates how telephone type stepping switches are used in industrial control circuit. For this automatic nailing machine control circuit, three 10-level stepping switches connected in parallel accomplish same function as approximately 40 relays which might have been used.

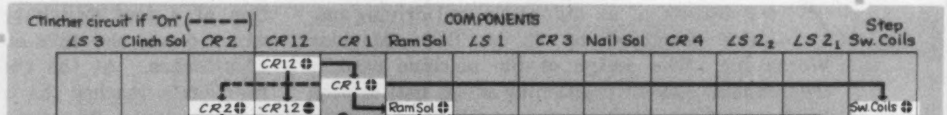


Fig. 3—Relationship of the actions of the major control components in an automatic cycle are shown. Dotted lines indicate how clincher operation fits into the automatic cycle.

July 1955). The use of three 10-level switches was dictated by the need for a minimum of 26 contact points per step and the lack of a suitable single switch that met this requirement.

Details of Operation

The circuit diagram, *Fig.* 2, shows how the stepping switches are employed. *Fig.* 3 indicates relationship of major components in the circuit. The rotary stepping switches, built by Automatic Electric Co., are of the indirect drive type, i.e., the wipers are advanced during release of the armatures rather than during magnetization of the coils, *Fig.* 4. When the coils of the switches are energized, drive springs are compressed and pawls are moved into engagement with ratchet teeth preparatory to moving the wiper assembly forward one step with demagnetization of the coils.

One of the flexible features of the machine is controlled by the *Cycle* 1-2 switch. With the switch set on *Cycle* 1, the control circuits are set to achieve the previously described automatic cycling involving up to 10 preset nailing patterns.

With the switch set on *Cycle* 2, it is possible to establish various nail patterns involving rows 1 and 2 in which nails called for by row 1 are dropped only by the right hand foot switch and row 2 only by the left hand foot switch. The operator then has available two patterns of nails to choose from and he may use either in any sequence of operations, depending on which foot switch is actuated.

If the clincher switch is activated, the clincher will lower from its normal position when the nailing ram starts down. When the nailing ram reaches the bottom of its stroke it pauses while the clincher rises to bend over the protruding points of nails on the underside of the work.

Automatic Cycle

Preliminary to following the control through an automatic cycle, it can be assumed that a desired nailing pattern has been set up on the control panel; selector switch marked *Cycle* 1-2 is set to the *Cycle* 1 position; clincher switch is set to *Off* position; and the hydraulic pump and pan-drive motors are started. With the preliminary switch arrangement as indicated, actions of relays *CR*2, *CR*10, and *CR*11 can be ignored as they are not pertinent to a discussion of the automatic cycle.

With the lumber in position, the right hand foot switch is closed by the operator and relay *CR*12 is energized, *Fig.* 2 and 3. Relay *CR*12 energizes relay *CR*1 which in turn energizes the *Ram Down* solenoid valve and the coils of the three stepping switches.

When the ram reaches the bottom of its travel, limit switch *LS*1 is closed and relay *CR*3 is energized; limit switch *LS*2 has been disengaged with the ram moving down, de-energizing the stepping switch coils, allowing the switches to step to the next nail pattern. In the resulting circuits, relay *CR*4 is energized and relay *CR*1 is de-energized. Relay *CR*4 seals itself in and closes its contact in the nail release circuit. When relay *CR*1 is de-energized the ram begins the return to its top position, opening limit switch *LS*1 which releases relay *CR*3 and returns its contacts in the nail release circuit to a normally closed position. With this action nails are released in accordance with the pattern set by the 24 selector switches in a row established by the stepping switches. As the ram reaches its top position, limit switch *LS*2 is again engaged, returning the control circuit to a condition ready to be operated by the foot switch, completing one automatic cycle.

Design of the circuit provides for one of the most important points to be observed in using stepping switches on industrial machinery: switching should occur only when the stepping switches are not under load. Much effort has been applied to the development of versatile switching equipment for the telephone control field. It is important to realize that this equipment is useful to the industrial control field. As this article illustrates, no matter how closely an item is associated with a particular field, it is the function performed by the component that determines its area of application.

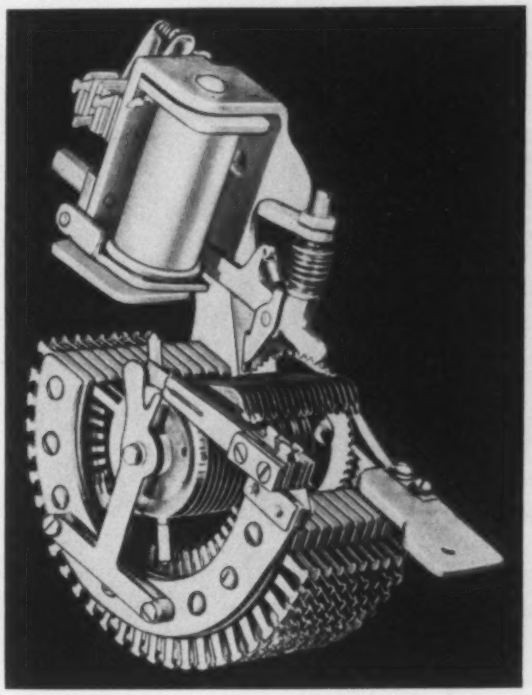
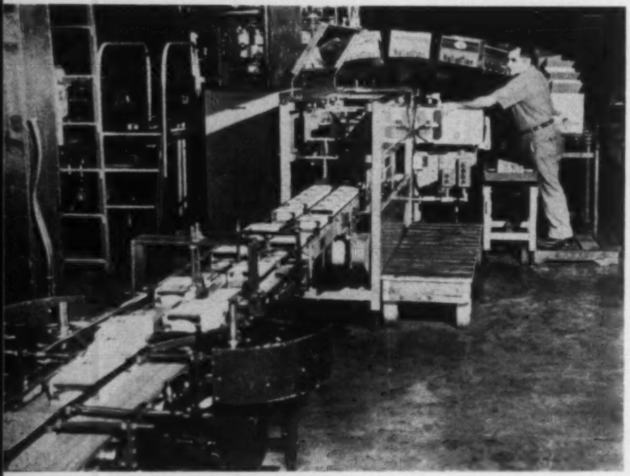
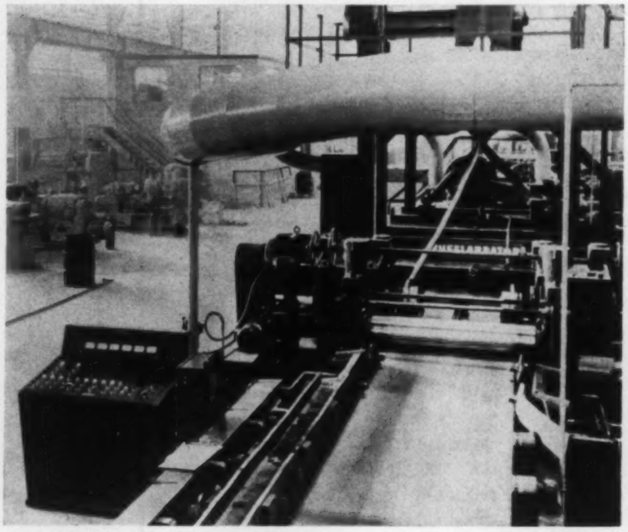


Fig. 4—Type of rotary stepping switch manufactured by Automatic Electric Co. used in control circuit. Switch contains 10 levels with 25 contact points in each level. In the nailing machine application, only sufficient contact points are used to establish 10 rows of possible nail patterns. Three switches in parallel establish required 24 contacts for nail feed and additional contacts for master selector switches and control lights.



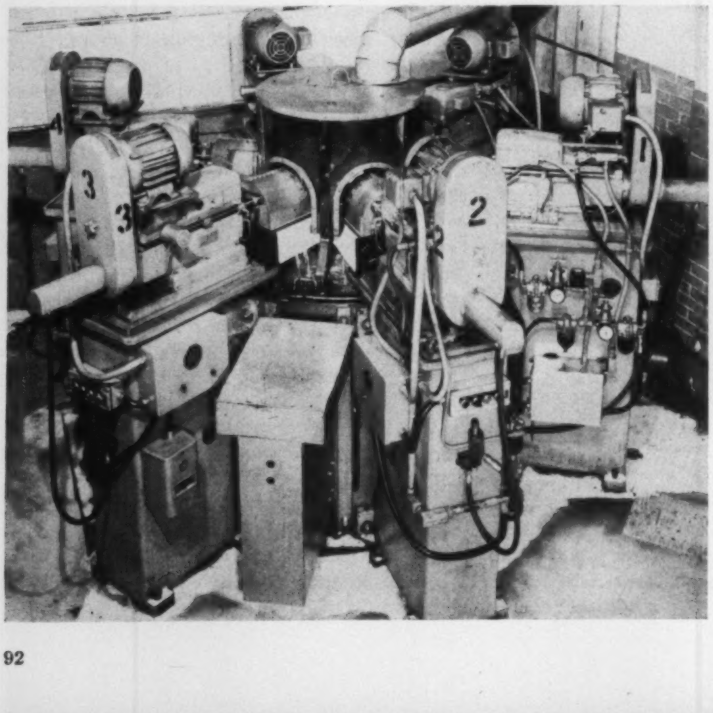
Case Loader

CONVERTIBLE case loading machine developed by J. L. Ferguson Co. can handle either six-pack or three-pack beer cartons. Shown in operation at Newark brewery of P. Ballantine & Sons, new machine places 8 of the six-pack or 16 of the three-pack cartons into corrugated shipping containers. After the loading operation, the container is automatically deposited open side up on conveyor leading to sealing operation.



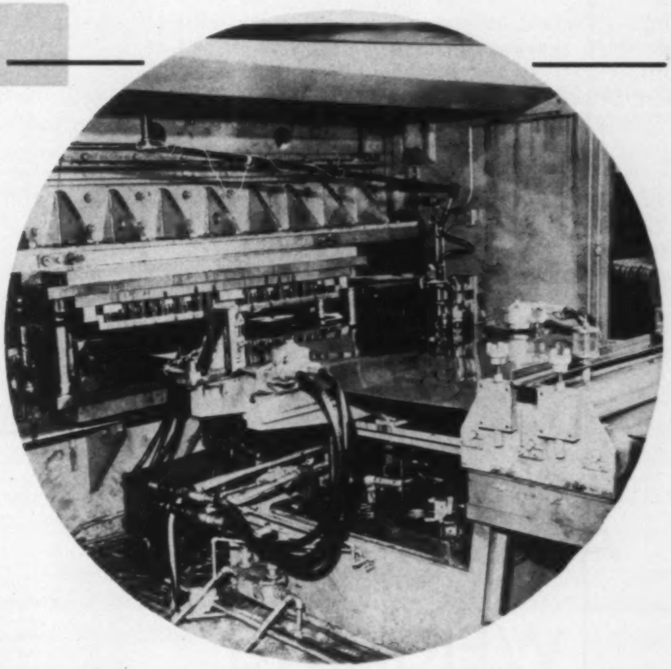
Pipe Production

NEW steel pipe mill built for Alberta Phoenix Tube & Pipe Ltd. employs mechanical descaling cabinet to clean edges of the skelp prior to welding. Depending on gage of steel, automatic resistance welder in line turns out pipe at speeds from 30 to 80 fpm. Descaler, furnished by Wheelabrator Corp., maintains proper cleaning pace in the operation involving production of approximately 150,000 tons of pipe per year, ranging in OD from 3½ to 16 inches.



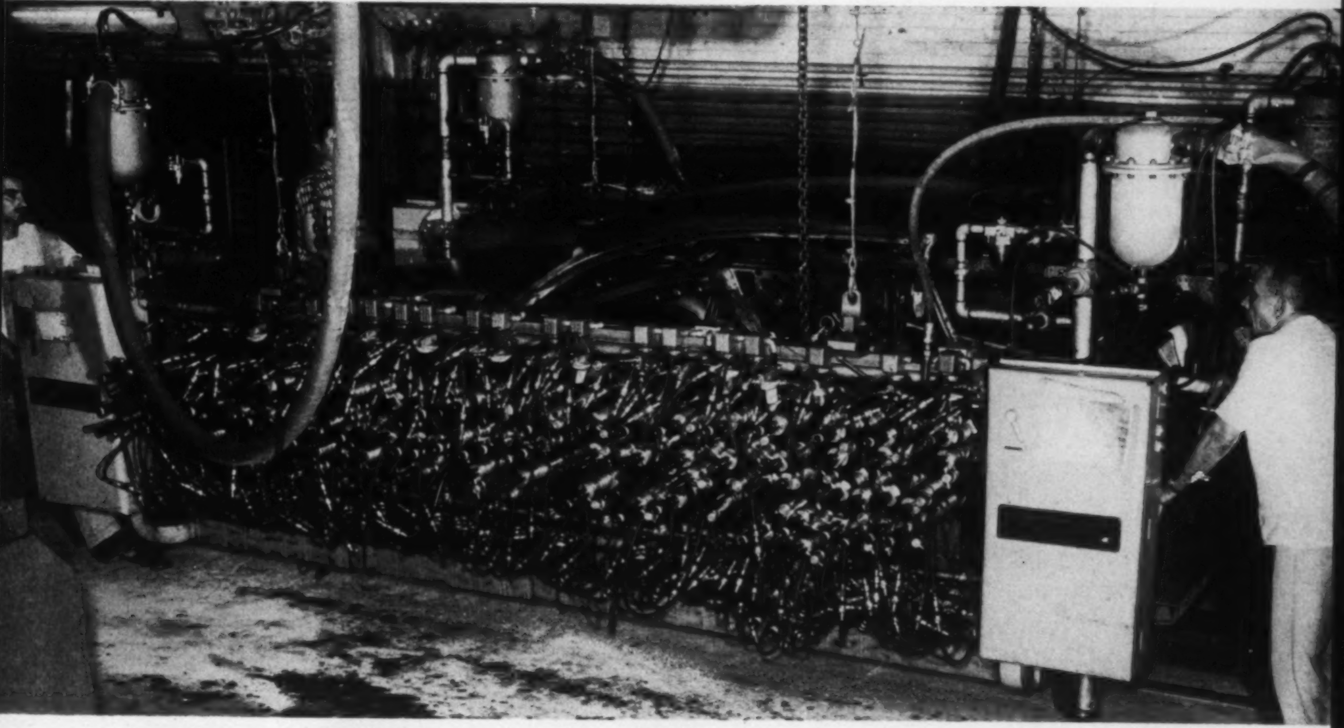
Special Multispindle Unit

UNABLE to find a manufacturer who would assume responsibility for designing a desired machine with requisite degree of automation and flexibility, Sprout, Waldron & Co. Inc. took the "do-it-yourself" approach. With purchased drill heads, controls, and miscellaneous parts, the company designed and built the illustrated automatic multispindle machine. The $100,000 installation employs drills to place pellet die holes in alloy steel rings which are used in extruding machines. Production time has been reduced from 90 hours, experienced with semiautomatic upright drills, to 6 hours with the automatic six-station machine.



Press Brake Setup

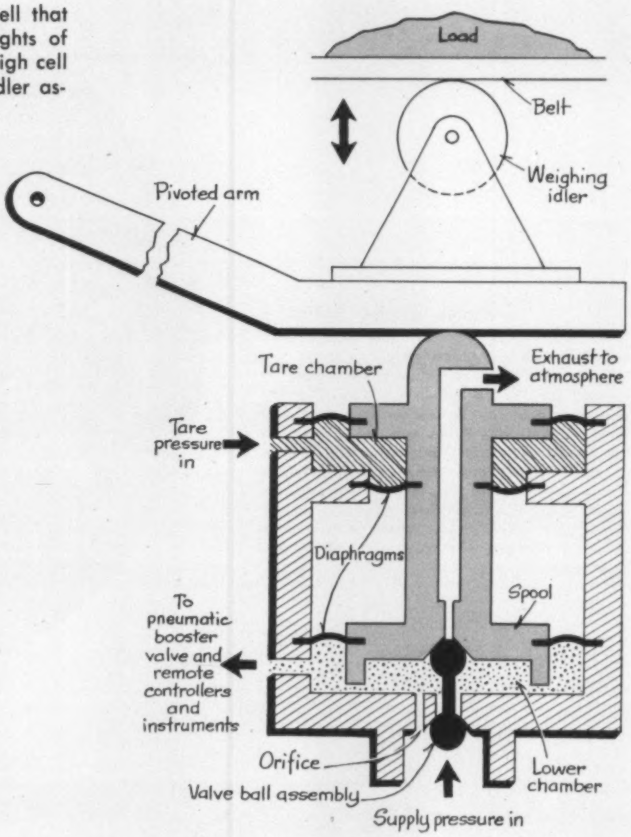
MATERIAL feeding system and progressive die have been installed on hydraulic press brake by Chicago Div., Young Spring and Wire Corp. for production of automobile seat components. Coiled sheet material, 57½ inches wide, is automatically fed through a 9-station progressive die mounted on the hydraulic press brake manufactured by Pacific Industrial Mfg. Co. to form rear rails, the major part of the seat frame. Hydraulic system holds ram momentarily in contact with work in order to distribute tonnage evenly as punches enter material.



Drill Fixture

EQUIPMENT containing 82 air-powered, automatic drill units is used to drill trim holes in automobile bodies. Typical unit permits pushbutton selection of one of eight different trim patterns, bringing into action from 19 to 40 drills. Developed by Gardner-Denver Co. for Chrysler Corp.'s Evansville Plymouth plant, fixture is attached to body by three air-powered clamps and is capable of moving along line as automobile body moves. Preparing trim holes on production line has eliminated the necessity of stocking a variety of doors with prepunched trim holes. Quantity of doors necessary to maintain production has been reduced about 75 per cent.

Fig. 1—Cutaway view of a pneumatic weigh cell that generates pressure signals proportional to weights of material passing over belt. Tare chamber in weigh cell provides a means of balancing out weight of idler assembly, spool, and belt for increased accuracy.


Load
Belt
Weighing idler
Pivoted arm
Tare chamber
Exhaust to atmosphere
Tare pressure in
Diaphragms
Spool
To pneumatic booster valve and remote controllers and instruments
Orifice
Valve ball assembly
Lower chamber
Supply pressure in

PNEUMATIC WEIGH CELLS IMPROVE AUTOMATIC WEIGHING AND BLENDING

By **W. E. MILLIGAN,**
Application Engineer
Builders-Providence Div.
B-I-F Industries Inc.
Providence, R. I.

Weight transducers, key elements in continuous belt weighing devices, are constantly undergoing improvements that adapt them to more precise measurements in a greater variety of industrial weighing and blending systems for bulk materials. Here are described some developments in pneumatic weigh cells and some of the applications for which they are used.

RECENT ADVANCEMENTS in continuous weighing technology are bringing forth many ingenious controlled weight delivery, straight pacing, and complete blending and proportioning systems for bulk materials. The weigh cell, heart of all these systems, must sense the weight of material passing over a conveyor and generate a signal proportional to this weight. Since the total weight delivered is determined by integrating the weigh cell signal with belt travel, the weigh cell must respond quickly and accurately to changes in belt loading.

In conveyor weighing the belt itself becomes the weighing platform, and is supported by a weigh cell. A pneumatic weigh cell having improved characteristics is diagramed in *Fig.* 1. In this design, the load is supported directly by a spool, which in turn is attached to the weigh cell body by three diaphragms. The vertical load on the spool consists of two components: A static load represented by the weights of the idler assembly, spool, and belt; and a dynamic load represented by the varying weight of material carried by the belt.

Counterweights are sometimes used to offset the effect of the static load on the weigh cell spool. This load may also be "tared out" pneumatically by regulating the pressure in the upper, or "tare" chamber produced by two of the diaphragms. Thus, the spool and the dead weight of the structure and belt may be supported pneumatically, avoiding the use of counterweights which would add inertia to the system.

A lower chamber and valve assembly serve to sense live weight variations. The valve ball assembly consists of two balls attached to a connecting rod. One ball seats in an opening in the spool. The other ball seats in an opening at the supply pressure inlet to the lower chamber.

Air admitted into the lower chamber raises the spool and ball valve to a balanced position such that both balls are seated. At this point the pneumatic force (pressure times effective area) acting upward on the spool will exactly equal the weight of live load acting downward. From this point on, any change in live load will act to unseat one of the two balls. If, for example, the live weight on the spool decreases, the force due to pressure under the spool will be greater than the force acting downward and the spool will rise. This exposes the channel in the spool and permits air to exhaust from the lower chamber through the spool to atmosphere. The air pressure in the lower chamber will then decrease and the spool will settle to its balanced position.

Any increase in the live load will move the spool and ball valve assembly downward, unseating the lower ball and permitting supply air to enter the chamber. This immediately increases the pressure in the lower chamber and returns the spool to its balanced position with both balls seated. Because of the fast response of this balanced-force system, travel of the spool need be only a few thousandths of an inch.

To improve response and sensitivity even more, a minute, continuous flow of supply air into the lower chamber may be provided by a small fixed orifice at the inlet connection. With this arrangement the system remains continuously responsive to small pressure changes even when relatively uniform live loads are being weighed. System inertia or "dead band" is thus minimized and sensitivity is at a maximum.

An advantage of the pneumatic weigh cell is in the magnitude of the signals generated. The relatively large (3 to 15 psi) signals from the pneumatic weigh cell require no amplification to improve accuracy and resolution. Linearity is readily obtained and relatively unaffected by fatigue, temperature, etc. Another characteristic inherent in the pneumatic weigh cell is its ruggedness. Any overload force applied to the spool will merely cause it to bottom on the cell body. The cell body can easily absorb the load and thus protect the more delicate elements of the weigh cell.

The pressure in the lower chamber of the weigh cell is directly proportional to the weight of material passing over the belt. For maximum accuracy this pressure is never used to do work. In control applications the pressure operates a pneumatic booster valve which in turn produces an output signal. This signal then actuates the controller. A pneumatic booster is also used when remote instruments are to be connected. Characteristics of the pneumatic force-balance weigh cell—accuracy, simplicity, ruggedness, reliability, and fast response—adapt it for many bulk material weighing applications.

▶ Weight Control Systems

Controlled delivery of bulks by weight has long been used to feed chemicals, minerals, and other bulk materials to processing systems. This may be accomplished through control of quadrant gate position, by control of belt speed through variable speed drives, etc. In these applications a weigh cell transmits a signal to a controller, the set point of which has been predetermined. The error signal, or variation from set point, is transmitted to a pneumatic positioner that adjusts the quadrant gate or variable speed drive. Such systems usually include proportional plus reset action.

Straight pacing, *Fig.* 2, is probably the oldest and simplest application of conveyor weighing to

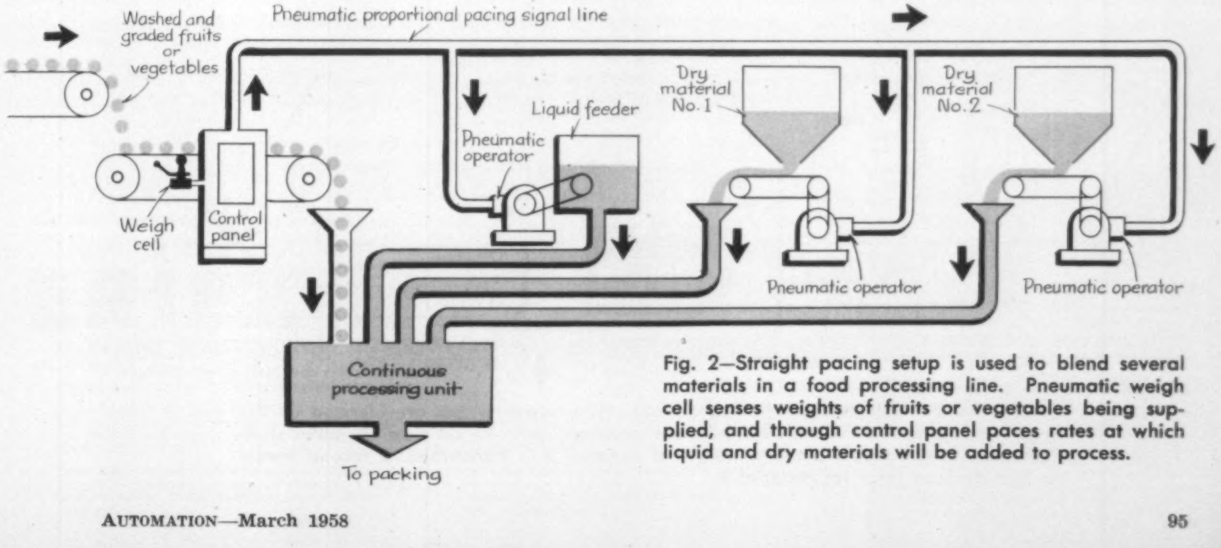


Fig. 2—Straight pacing setup is used to blend several materials in a food processing line. Pneumatic weigh cell senses weights of fruits or vegetables being supplied, and through control panel paces rates at which liquid and dry materials will be added to process.

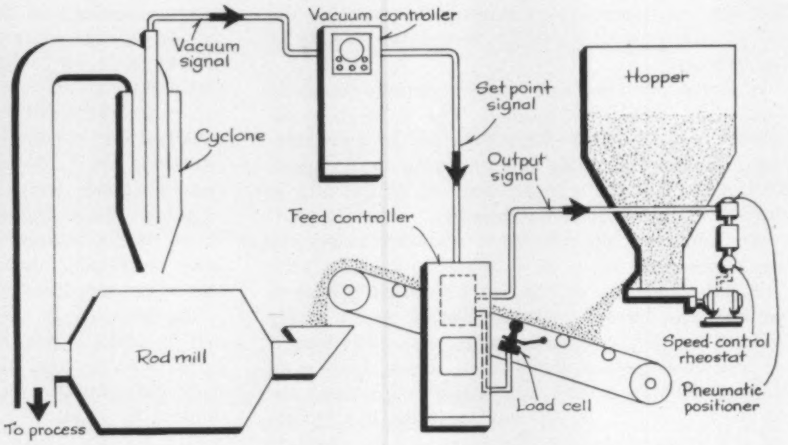

Vacuum controller
Vacuum signal
Set point signal
Hopper
Cyclone
Output signal
Feed controller
Rod mill
Speed-control rheostat
Pneumatic positioner
Load cell
To process

Fig. 3—Paced controller principle is used in this rod mill to effect "throughput" control. Vacuum in cyclone, which is an index of rate at which material can be added, paces set point of feed controller. Two control loops are used: One loop controls vacuum by adjusting rate at which material is added to rod mill by conveyor; other loop determines rate at which material will flow onto conveyor from storage hopper. Control systems are cascaded so that set point of feed controller is adjusted by vacuum controller.

proportioning or blending. In this system the output signal of the weigh cell paces an additive feeder or group of feeders to assure accurate proportioning. The proportional ratio may be present by the operator, and can be changed as required.

In the paced controller system, the weight of material in a primary flow is used to adjust the set point of a controller governing delivery of a secondary material. This is used when the secondary flow does not lend itself to volumetric control feeding, but requires a complete control loop. This situation commonly arises in blending bulk materials such as minerals and chemicals.

The paced controller system can also be used for "throughput" control. One application is in a rod mill, *Fig.* 3, where the vacuum in the cyclone is an index of the efficiency of operation and rate of material which the mill can handle. Here the vacuum signal is used to adjust the set point of the feed controller, and two control loops are used. One loop controls the vacuum by adjusting the rate of material being added to the rod mill by the conveyor. The other loop controls the rate of material delivered from the storage hopper to the conveyor by adjusting the rate of the hopper feeder. The two control systems are cascaded so that the set point of the feed controller is adjusted by the vacuum controller. This combination is very successful.

Another method of blending two process materials is shown in *Fig.* 4. In this system, the rate of feed of material *A* is governed by the action of a controller on a quadrant gate positioner. A pneumatic signal that is proportional to the weight of material *A* is fed to a second feeder to control the feed of material *B* through the action of a pneumatically operated speed changer on a feeder rotor. This is an example of control of the blending of two materials having different flow characteristics and which require different feeding means.

Many other continuous weighing arrangements are possible using the pneumatic weigh cell as the means of signal generation. The few mentioned here serve to illustrate the major types of systems in common use and to emphasize the variety of applications for which they are suited.

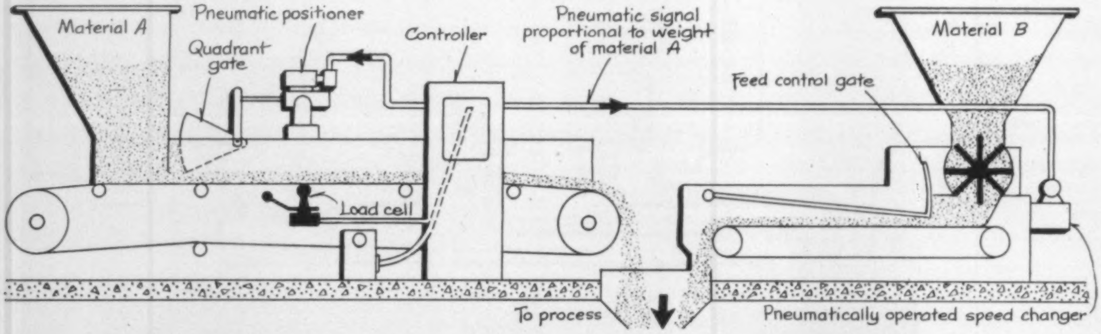

Material A
Pneumatic positioner
Quadrant gate
Controller
Pneumatic signal proportional to weight of material A
Material B
Feed control gate
Load cell
To process
Pneumatically operated speed changer

Fig. 4—Two process materials having different flow characteristics are blended by this proportioning system. Controller positions quadrant gate to set flow of material A. Pneumatic signal proportional to weight of material A is transmitted to second feeder to operate feed rotor for material B.

ERIEZ MAGNA-RAIL UNITS SPEED UP CONVEYOR LINES, CONSERVE VALUABLE FLOOR SPACE!

Small, lifetime-powered magnetic automation elements fastened under conveyor belts provide safe, positive hold for ferrous parts; swiftly convey, control and elevate up inclines as steep as 80°; increase safety conditions and reduce damaged parts.

Speed up production and reduce operating costs with Eriez Magna-Rail! These units, fastened under existing lines or incorporated into new ones, turn ordinary belt conveyors into **magnetic** conveyor-elevators that are able to move ferrous materials and parts at greatly increased speeds.

Powerful magnetic action of Magna-Rails holds items such as nails, caps, cans, stampings, scrap, finished parts, etc. at fast speeds even up (or down) inclines as steep as 80°. Convey on both top and bottom sides of your lines . . . automatically turn conveyed parts over . . . change direction of flow, etc. Use of steeply inclined conveyor lines shortens belt lines, permits machines to be more closely grouped together. Positive hold prevents items from slipping off the line; improves safety conditions, reduces damaged parts.

Magna-Rail is a 4" wide assembly, standard lengths from 3' to 6', containing a series of Alnico V non-electric magnets. The unit is available in straight or curved sections for direction change of a conveyor line. Magna-Rail will **automatically** convey, control or elevate material from one machine (or operation) to another, with automatic discharge where required. When used with other Eriez HI-POWR magnetic equipment, these units offer unlimited automation advantages.

Lightweight and simple in design, Magna-Rails are easily incorporated into present conveyor lines. No outside power is needed, and maintenance is nil. Magnetic strength is guaranteed indefinitely.

• • • • • • • •

Eriez does not design, build or sell material-handling systems, *but we serve people who do* in areas where magnetic equipment should be incorporated. We willingly share the design-and field-application know-how gained through helping others move materials faster, more economically, more efficiently and more accurately by utilizing the inherent advantages of magnetism. Specifically, we produce standard lines of magnetic equipment and, in addition, design and build special components to *magnetically* convey, transfer, control, elevate, re-position, hold or re-orient basic ferrous material or finished parts. As our engineers work very closely with both system manufacturer and ultimate user, the most efficient installation is the end result.

ERIEZ MAGNA-RAIL UNITS PROVIDE THESE IMPORTANT AUTOMATION ADVANTAGES:

• Magnetic strength is guaranteed indefinitely; first cost is the only cost • Completely non-electric; no wires or attachments • Easily incorporated into new or existing equipment • Virtually no maintenance; magnets are trouble-free • Compact size: 4" wide, $1\frac{15}{16}$" high. Standard sizes are 3, 4, 5, 6 ft. (special sizes made to order) • Safe, positive hold • Permits faster conveyor speeds in less space • Lightweight; simple design • Eliminates manual handling, reduces damaged parts • Conveys up inclines as steep as 80° • Many magnetic strengths

Produced under Patent 2, 551,947.

***BIG, NEW BULLETIN** on magnets for automation.*

For your free copy, write:

ERIEZ Manufacturing Company
119C Magnet Drive, Erie, Pa.

ERIEZ HI-POWR
MAGNETS FOR AUTOMATION

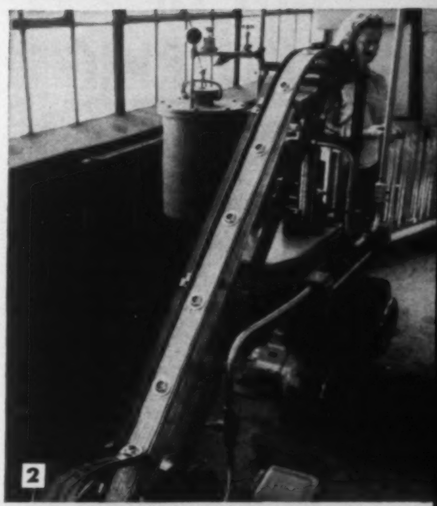
PIONEERS AND WORLD'S LARGEST PRODUCERS OF PERMANENT NON-ELECTRIC MAGNETIC EQUIPMENT AND NEW HI-VI ELECTRO PERMANENT MAGNETIC VIBRATORY EQUIPMENT

MAGNA-RAIL SOLVED THESE CONVEYING PROBLEMS:

1. **Cleveland Graphite Bronze Division, Clevite Corp.** Problem: to secure bushings and bearings to a conveyor belt without marring their close tolerances and mirror finish by sudden belt stops or inclines. Solution: MAGNA-RAIL
2. **Sherwin Williams Company.** Problem: to convey paint can tops more quickly without having them slide off the line and to discharge them automatically at the rate of about 100 per minute. Solution: MAGNA-RAIL
3. **R. T. French Company.** Problem: to elevate caps for mustard jars up a steep incline, over a conveyor line, and automatically release them into the hopper of a capping machine. Solution: MAGNA-RAIL
4. **National Can Company.** Problem: to convey can ends at the rate of 200 per minute from a press to a coater, without danger of the ends sliding off the line at this rate of feed. Solution: MAGNA-RAIL

Circle 686 on Page 17

1



2

3

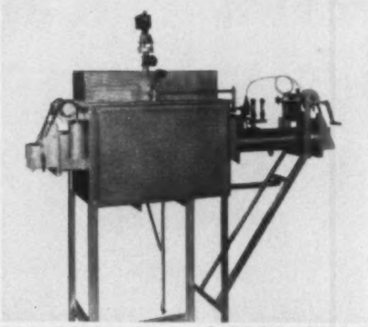
4

NOW

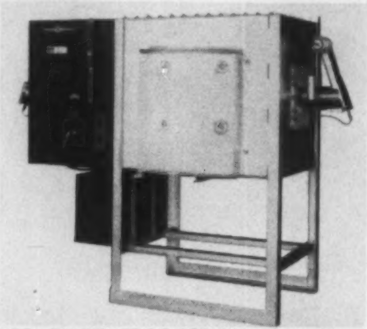
TAKE THE SIN OF SPOILAGE OUT OF SINTERING

with Hayes "application-rated" furnaces!

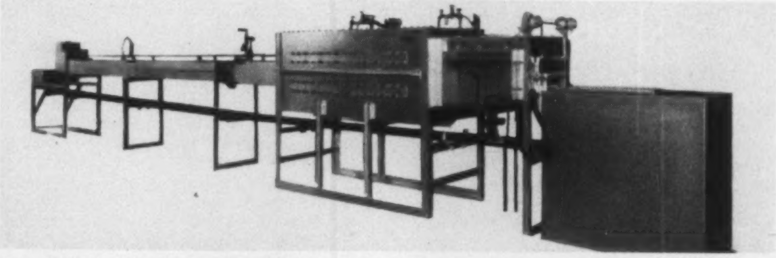
For Ferrous or Non-Ferrous Powder Compacts, Hayes has an atmosphere or a vacuum furnace to suit your sintering needs . . . in research, pilot production, quantity production, or specialty sintering. For optimum results at lowest cost, request complete data on any furnace shown . . . or for unusual applications, request obligation-free "Results Guaranteed" recommendations.



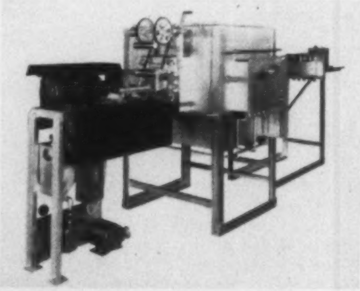
FOR RESEARCH and PRODUCTION Hayes Type MY furnaces (molybdenum-wound element) provide uniform heat to over 3000° F. These low cost units can be used with variety of reducing atmospheres . . . are perfect for sintering research . . . or production at high temperatures. Hayes high temperature vacuum cold-wall furnaces also provide production facilities for applications over 3000° F.



FOR PILOT PRODUCTION Hayes Type BA-M pusher furnaces are inexpensive, offer controlled-atmosphere, straight-through models with water-cooled cooling chambers. Suitable for batch, manual or automatic pusher operation . . . up to temperatures of 2150° F. Wide size range to suit any pilot-scale project on powdered metal compacts. Also available in conveyor type furnaces for production use.



FOR QUANTITY PRODUCTION Hayes Type LAC conveyor furnaces: belt furnaces offer continuous, automatic, uniform sintering of compacts at temperatures up to 2100° F. . . . with pusher type handling heavier parts requiring temperatures to 2350° F. Both designs offer zone temperature control . . . and preheat sections, if desired . . . making *standard units* suitable for stainless steel work.



FOR SPECIALTY SINTERING Hayes Type BA pusher furnaces are special, wide-temperature-range sintering and impregnating furnaces suitable for 2350° F operation. Can be used with varied atmospheres . . . with automatic, electro-hydraulic pusher system for maintaining constant time/temperature cycles for batch or production.

ACT NOW! Request complete data on these furnaces, on atmosphere equipment, or any allied products in Hayes well-known CERTAIN CURTAIN electric furnace line. Write today!

FREE LITERATURE

ELECTRIC CERTAIN ® CURTAIN FURNACES

C. I. HAYES, INC.

Established 1905

813 WELLINGTON AVE. • CRANSTON 10, R. I.

Please send me complete data on sintering equipment suitable for: 813

☐ RESEARCH

☐ PILOT PRODUCTION

☐ QUANTITY PRODUCTION

☐ SPECIALTY SINTERING (You name it!)

☐ ATMOSPHERE EQUIPMENT

Name .... *Title* ....

Company ....

Street ....

City .... *State* ....

Circle 687 on Page 17

AUTOMATION

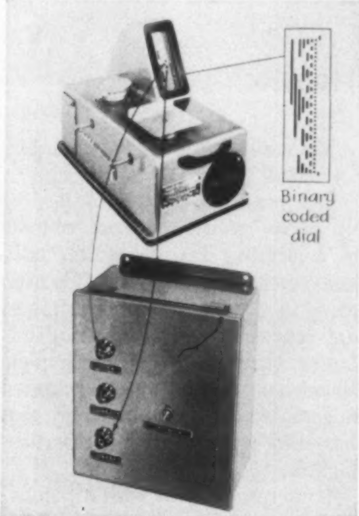
new equipment

Machines and plant equipment designed for more automatic operations

For detailed information and literature, use card page 17

Photocells Automate Basic Weight Classifier

DEVELOPMENT of the crystal photocell system for Shadograph Scales manufactured by **Exact Weight Scale Co.**, 538 E. Town St., Columbus 15, Ohio enables this type of weighing equipment to be more readily adapted to automated weighing operations. In the basic weight classifier pictured at the left, crystal photocells are mounted adjacent to the visual dial to provide an accurate and reliable means of producing an electrical signal when limits (tolerance settings) are reached.



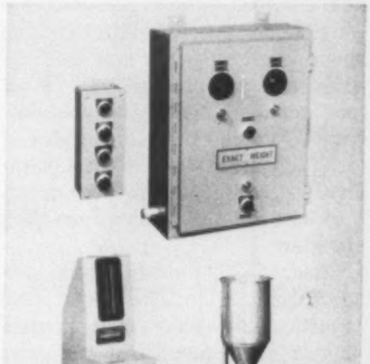
Each photocell will operate a relay at an adjustable preset weight value to an accuracy of better than two times the advertised visual scale sensitivity. From two to seven cells can be mounted across the optical dial to provide any number of classification from 2 to 128. The larger number of classifications is accomplished with the use of a projected binary coded "Gray scale."

A controller is used with the Shadograph Scales. This unit operates relays to open or close circuits when the preset weight reading is reached. This controller may be used to actuate automatic transfer machines and operate counters, visual signal lights, or alarm signals. The controller can also actuate permanent visual chart recorders for statistical quality control of processes.

The Shadograph Scales used in the Basic Weight Classifier is offered in 34 different models. Capacities range from 2000 milligrams up to 100 pounds. Commodity receptacles and platters are available to accommodate any size or shape product. Visual reference to the weight indication is provided by a hairline on an illuminated scale dial.

Features of the system include: Direct correlation between the scale dial reading and the photocell transducer; printed circuit transistor amplifier which provides extreme stability; accuracy independent of normal line voltage variations; scale available with either metric or avoirdupois values.

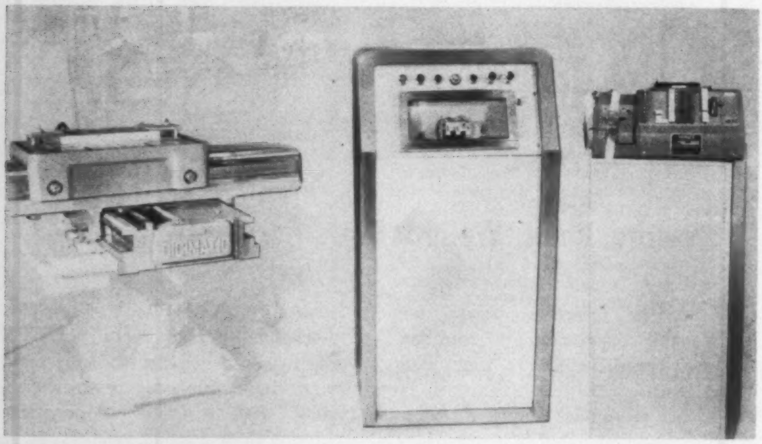
An example of this basic weighing control system applied to an automatic weighing machine is illustrated by the picture at the right. Designed for extremely accurate weighing of chemicals, drugs, and dry products, the unit combines accuracy with automatic operation. Designated as Model 4600NW, the automatic net weigher delivers accuracies of 1/10 gram on quantities below 10 grams and 1 per cent accuracy on quantities of 10 grams and above. One part in 1000 accuracy has been achieved on certain products.



In the model shown, the vibratory feeder delivers product to the weigh hopper until the predetermined weight has been reached, and then automatically shuts off, at which time the hopper releases the weighed quantity. In this application two crystal photocells are mounted on the scale dial and control the vibratory feeder. These photocells are adjustable and permit setting the net weigher to the closest tolerance in accordance with the feeding characteristics of the product.

Other features include visible signal lights, even-lever balance scale, and visual weight indication on the scale dial. Hoppers and vibratory feeders have adjustments for product flow. Machine may be operated as a fully automatic unit, as a semiautomatic machine, or manually for single weighing.

Circle 401 on Page 17



Electronic Worktable Positioner

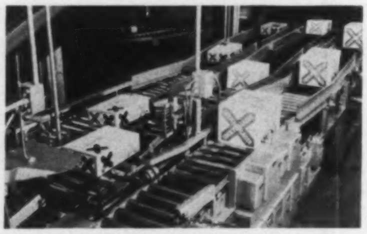
Item 402

Automatic table positioning system designed for drill presses is also suitable for spot welding, riveting, engraving, tapping, and countersinking operations requiring point positioning. Machine features flexibility for all sizes and patterns of drilling jobs, drilling accuracy within 0.001-inch, speed in positioning, and ease of programming from shop drawings.

Model C-202 consists of three separate units: a punched tape preparation unit which can prepare tapes for any number of machines; a tape reader and control unit which uses the punched tape directly; and a compound servo table which positions the work under the desired size drill. The system can be adapted to any existing drilling machine without modifying the drill itself.

The decimal co-ordinates of each hole to be drilled can be prepared in the engineering department by transferral directly from the dimensions on the drawing. The operator strikes the proper keys for hole position and drill size on the tape preparation unit. These instructions are automatically recorded in the form of perforations on paper tape. Then the punched tape is placed in the tape reader and control unit, *Start* button pressed, and the information is translated from the tape into electrical commands that position the table and operate the drills. Engineering changes during a production run can be made by inserting the proper holes in the original tape. **Electronic Control Systems Inc.**, 2136 Westwood Blvd., Los Angeles 25, Calif.

Circle 402 on Page 17

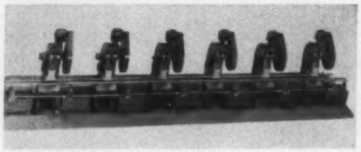


Carton Segregator

Item 403

Suitable in brewery, bottling, cereal, and other package handling plants, automatic segregating device permits different size cartons and cases to run on a single conveyor. Device is usually installed in a conveyor line at the point of final distribution. As each case from the single conveyor line enters the segregator, mechanical fingers measure the case height and length, then send the case straight ahead on the original conveyor or cause it to be transferred to parallel conveyors to the right or to the left. Each of the parallel conveyors can be equipped with a segregator, so any number of different case sizes can be sorted onto separate conveyors. Segregator can be used in connection with automatic palletizing equipment. It permits the feeding of each case size to its respective palletizer on a short run of individual conveyor rather than many long lines of conveyor from the original filling or packaging areas. **Material Handling Section, Food Machinery and Chemical Corp.**, Riverside, Calif.

Circle 403 on Page 17



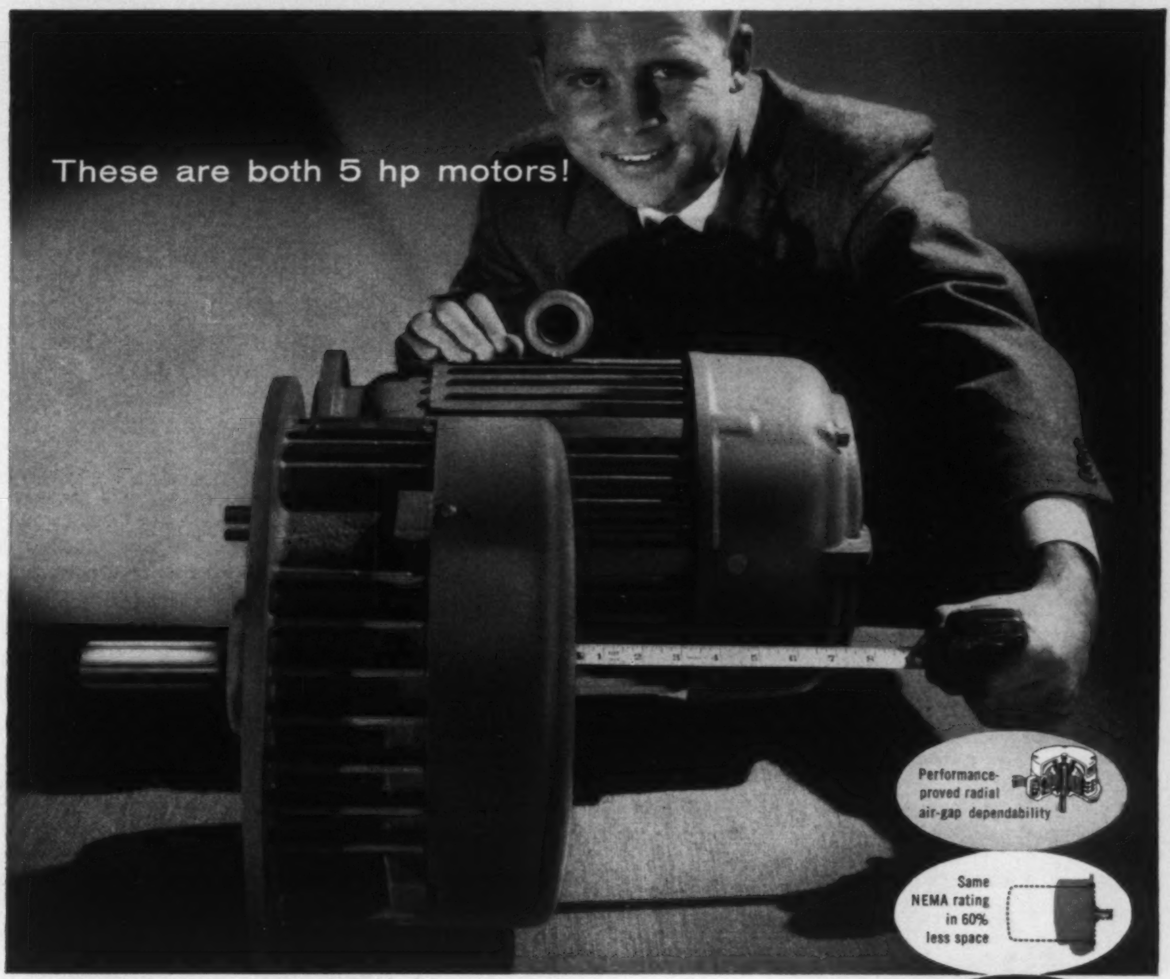
Transfer Device

Item 404

Mechanism is designed to transfer small piece parts through a single press or through a line of up to six presses. Device consists of a clearing Transflo power unit, and one intermediate unit for each press in the line. Transfer fingers are replaceable to accomodate different piece parts. The complete finger bar assembly can be removed and replaced with an assembly that has been preadjusted for a particular job.

Unit can be used with all standard sizes of open back inclinable presses from 45 to 200 tons. Feed can clear a 37-inch front to back part dimension. The right to left dimension is limited only by the length of feed stroke. Piece parts weighing as much as eight pounds can be handled by the feed. **Clearing Machine Corp.**, 6499 W. 65th St., Chicago 38, Ill.

Circle 404 on Page 17


These are both 5 hp motors!
Performance-proved radial air-gap dependability
Same NEMA rating in 60% less space

60% shorter— but with radial air-gap design!

New Louis Allis Pancake Motor preserves all the advantages of conventional motor construction

The new Louis Allis Pancake Motor is your solution to trouble-free power in any space-cramped motor application. The Pancake is a remarkably short flange-mounted motor — up to 60% shorter and 33% lighter than standard motors of the same rating! And it is built in *conventional* radial air-gap design!

It's done by an ingenious forming process which literally compresses the end coils of a conventional radial air-gap motor into an exceptionally short length. The result is a compact, light motor ideally suited for horizontal or vertical mounting on machine tools, roof ventilating fans, or *any* close-quarter installation where space is a critical design factor.

What's more, this is achieved without sacrificing a single desirable characteristic: the stator still contains the same iron and copper as standard Louis Allis motors . . . standard NEMA service factor is maintained . . . high insulative values are retained by using proved Louis Allis varnishes and new insulating techniques . . . over-sized pre-lubricated bearings are used to guarantee long bearing life . . . and the entire motor is enclosed in an industrial-type cast-iron housing designed to shrug off abuse!

The housing and flange are cast in one piece: this permits extra-accurate internal machining which extends bearing life and reduces noise levels to a new low.

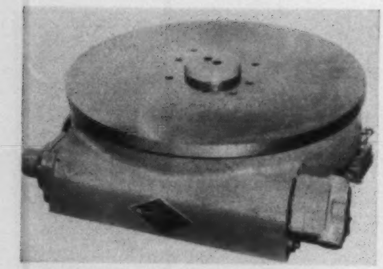
Investigate the Pancake Motor through your local Louis Allis District Office. Sized from 1 to 15 hp, at 1800, 1200, and 900 rpm, in open drip-proof and enclosed non-ventilated or fan-cooled enclosures. Write for Bulletins 2100 and 2150 to the Louis Allis Co., 463 E. Stewart St., Milwaukee 1, Wis.

SM-101

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

Circle 688 on Page 17



Dial Index Table

Item 405

Table is 26 inches in diameter, can automate drilling, tapping, rivet-spinning, chamfering, welding, and screwdriving machines. It can index a weight of up to 2000 lb, and can be equipped with as many as 12 stations. Model GEM-26 can index to ± 0.001-inch on a 24-inch diameter work circle. Workpieces are positioned in as little as 2/3 second. Index table is equipped with a rotary air motor, solenoid valve, and limit switch. Electric and hydraulic motors are also available. **Gray Equipment Co.**, 13600 Ford Rd., Dearborn, Mich.

Circle 405 on Page 17

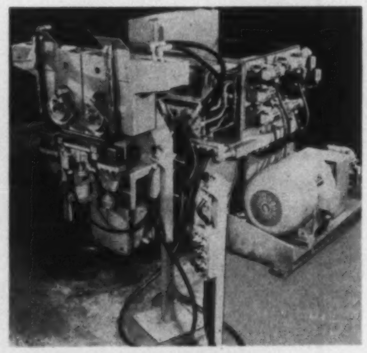
Tape Programmer

Item 406

Device can control as many as 85 individual load circuits, will function from a variety of bases such as analog, digital, temperature, and feedback. For each foot length of tape there are 64 possible steps. Memory load relays which are available with the unit, are actuated by a pulse transmitted through the punched hole in the tape. This circuit remains energized until a second pulse is transmitted through a subsequent hole in the same channel in the tape. All circuits can be returned to normal at the end of the cycle or in any position as required.

Programmer is self homing, has indicating lights for steps in the program, and pilot lights for each load circuit. Programs are changed by inserting a different tape. Optional equipment is a dual timer which permits the unit to operate from a time base. **Industrial Timer Corp.**, 1407 McCarter Highway, Newark 4, N. J.

Circle 406 on Page 17



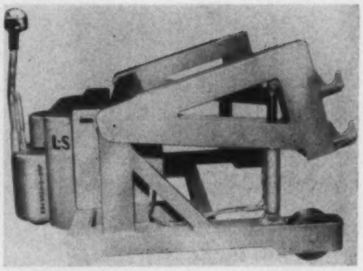
High Speed Bender

Item 407

Efficient loading and unloading are a feature of special high speed bender. U-shaped radiator support channel shown being formed takes two 90 degree bends on a 3¾-inch inside radius. Production rate is 1000 bends per hour. Material handling in and out of the bender is facilitated by the vertical design which has two pivoting heads that form two 90 degree bends simultaneously.

In operation, the channel is loaded into the dies and the *Start* button is pressed. The bending forms, mounted on pivoting heads, move in to clamp the workpiece and begin the bends. Wiper shoes move vertically to form the channel around the bending forms. After completion of the bends, the heads retract and the finished workpiece is ejected automatically. The hydraulically-operated machine has cushion-type cylinders which minimize shock at the end of the stroke and prolong the life of the working parts. Power is supplied by a single 20 hp motor. **Pines Engineering Co. Inc.**, 601 Walnut St., Aurora, Ill.

Circle 407 on Page 17

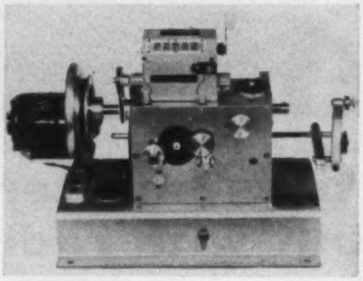


Reel Handling Truck

Item 408

Battery powered machine is capable of handling cable reels of varying sizes. Maximum cable reel diameter that can be handled is 90 inches, and the minimum 36 inches. Twin hydraulic cylinders, one attached to each lifting arm, are synchronized to lift simultaneously. Lifting and lowering controls, and brake, traction, direction, and horn controls, are located in the handle head. Truck can operate even with the handle in full vertical position. **Lewis-Shepard Products Inc.**, Dept. R-21, 125 Walnut St., Watertown 72, Mass.

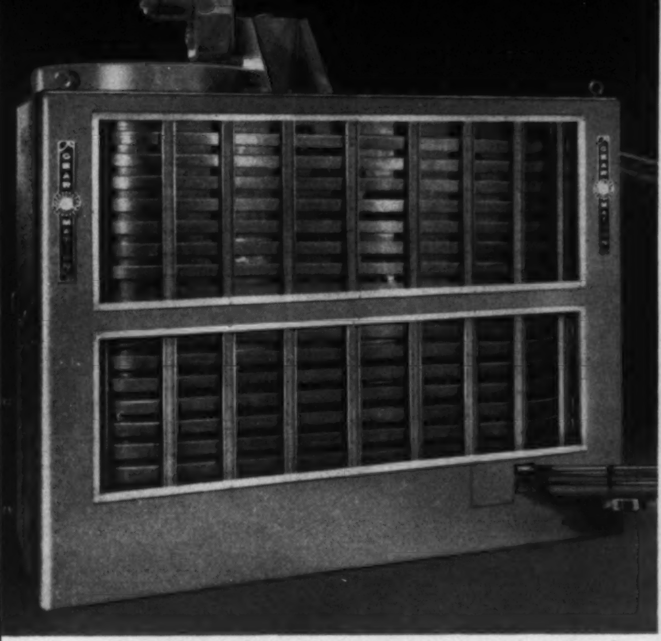
Circle 408 on Page 17



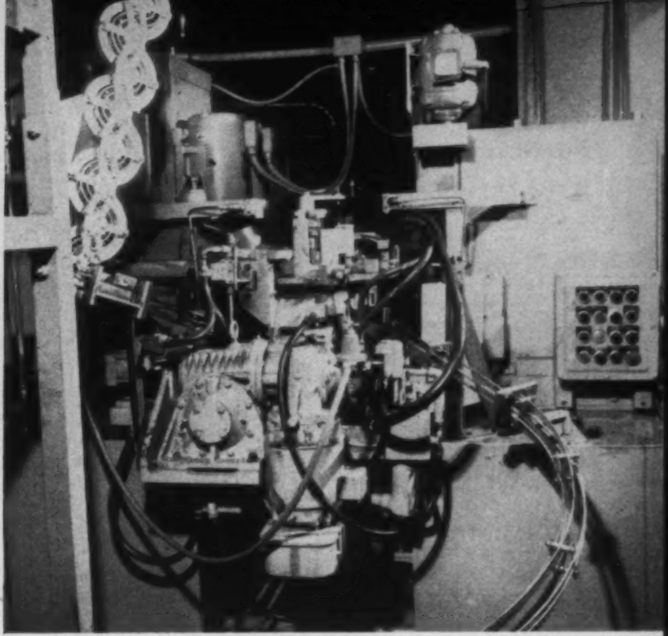
Bobbin Winder

Item 409

Device eliminates need for gear changing or cam substitution, provides for adjustment of wire feed without tools. Three basic adjustments can be made with the machines running if desired. One knob regulates the wire spacing from about 10 to 500 turns per layer, a second knob adjusts the traverse lengths as indicated by a dial calibrated in sixty-fourths of an inch, and a third control knob is used to center the winding between the coil flanges. The cam throw can be set to within 0.003 inches using the dial reading. Wire guides for the machines are con-

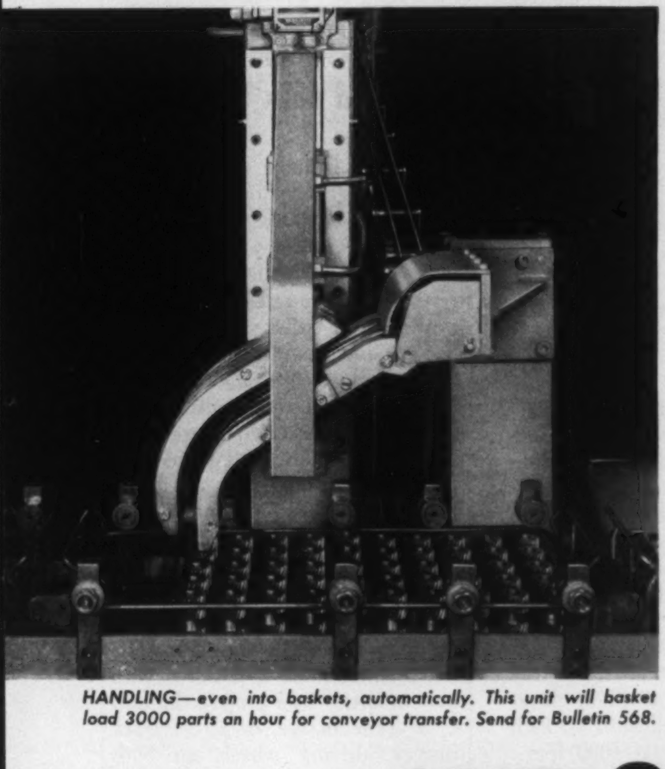


STORING—3000 parts or feeding 5000 parts an hour. Details on G-O-M's newest storage unit available in Bulletin 571. Write for it.



LOADING—and unloading of machine tools is easy with G-O-M's pre-engineered devices. Ask for information on application to your parts.

New automatic handling units to cut costs!



HANDLING—even into baskets, automatically. This unit will basket load 3000 parts an hour for conveyor transfer. Send for Bulletin 568.

Now, more than ever, Gear-O-Mation makes it easy for you to solve the costly problems of process parts handling. How? With functionally designed, readily adaptable equipment to move parts into, through or from various operations—automatically and with full control. The parts? All kinds. Gear-O-Mation has worked with parts from small blanks to heavy castings. Gear-O-Mation's extensive standard line is pre-engineered for simple modification that "tailors" the equipment to your parts.

For automating parts in process, whether to a single machine or a full line, in large or small shops, Gear-O-Mation should be your first call. If your parts require demand control, selective feeding, active storage or positive movement, there's no better source, no better equipment.

Circle 689 on Page 17

GEAR-O-MATION

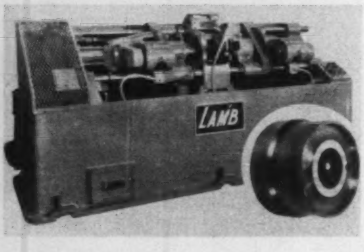
DIVISION OF MICHIGAN TOOL COMPANY

7171 E. McNICHOLS ROAD • DETROIT 12, MICHIGAN

WASHERS • STORAGE UNITS • ELEVATORS • SKEW LOADERS • BASKET LOADERS • DISTRIBUTION SYSTEMS
DEMAND FEEDERS • MACHINE LOADERS AND UNLOADERS • ORIENTORS • SIZE CLASSIFIERS
HOPPER FEEDERS • ASSEMBLY DEVICES AND SPECIAL EQUIPMENT

structed so they can be used in front or behind the coil. **Coil Winding Equipment Co.,** Oyster Bay, N. Y.

Circle 409 on Page 17

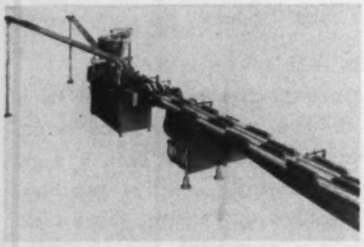


Burnishing Machine

Item 410

Device is capable of burnishing two opposing faces of a cast iron transmission drum (inset) at the rate of 360 pieces per hour. The transmission drums are gravity chute fed and clamped by a spring loaded pressure pad. Machine, fixture, and burnishing tool design eliminate critical part positioning. Two opposing machine heads with preloaded taper roller bearing spindles are carried on a single set of floating guide bars. Hydraulic pressure against one sliding head simultaneously pulls the other head which is clamped to the guide bars and yoke. Pressure of both burnishing tools is equalized, and results in a uniform finish on both faces. Opposing tool rotation and pressure equalization also eliminates machining torque and part slippage. Burnishing time is adjustable from 1 to 55 seconds. **F. Jos. Lamb Co.,** 5663 E. Nine Mile Rd., Detroit 34, Mich.

Circle 410 on Page 17



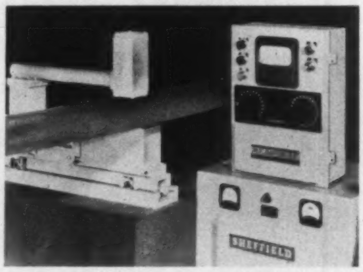
Cookie Processor

Item 411

Machine sandwiches cookies, delivers them stacked or flat in groups or continuous rows at speeds of 1400 per minute. Unit consists of Model GT which handles bakery from the oven and shapes round, square, rectangular, and half-round sandwiches; and Model GTB which counts and stacks the sandwich cookies and delivers them ready for packaging in bags, trays, or cartons.

Base cakes are fed from the oven to magazines and then to twin conveyors. The sandwich filling is rolled onto the moving base cake by a revolving depositing sleeve. Top cakes are automatically positioned on filling-covered base cakes and firmly pressed to assure adherence and uniform sandwich thickness. Cookie sandwiches can be stacked on edge or delivered flat, depending on the type of package. They can be counted into groups or delivered to packaging conveyors in continuous rows. **Peters Machinery Co.,** 4700 N. Ravenswood, Chicago 40, Ill.

Circle 411 on Page 17



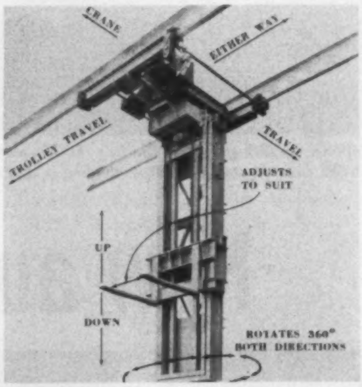
X-Ray Gage

Item 412

Instrument can scan film and foil traveling at 100 fps, and measure strips 0.0002-inch thick with accuracy of millionths of an inch. Materials such as plastic film, foils made of steel, aluminum, copper or brass, and sheet and bar stock, can be checked with this device. Using pulses instead of continuous radiation, the unit can take up to 36,000 individual readings per minute on continuous strips of material. At 600 pulses per second the X-ray gage provides an individual thickness reading every third of an inch on foil fed through at 1000 fpm.

The X-ray pulse passes through a strip that comes between the emitter and receiver of the scanning unit. The receiver detects and amplifies the X-ray energy that manages to get through. A slight increase in thickness means less energy received. Detecting and amplifying this difference, the gage registers it on an indicator in millionths of an inch or as deviation in per cent, plus or minus. Indicator is located in a remote control station. Instrument is suitable for use with production analyzers, automatic thickness controlers, recorders, totalizers, and other accessory devices. **Sheffield Corp.,** Dayton, Ohio.

Circle 412 on Page 17



Overhead Fork Lift

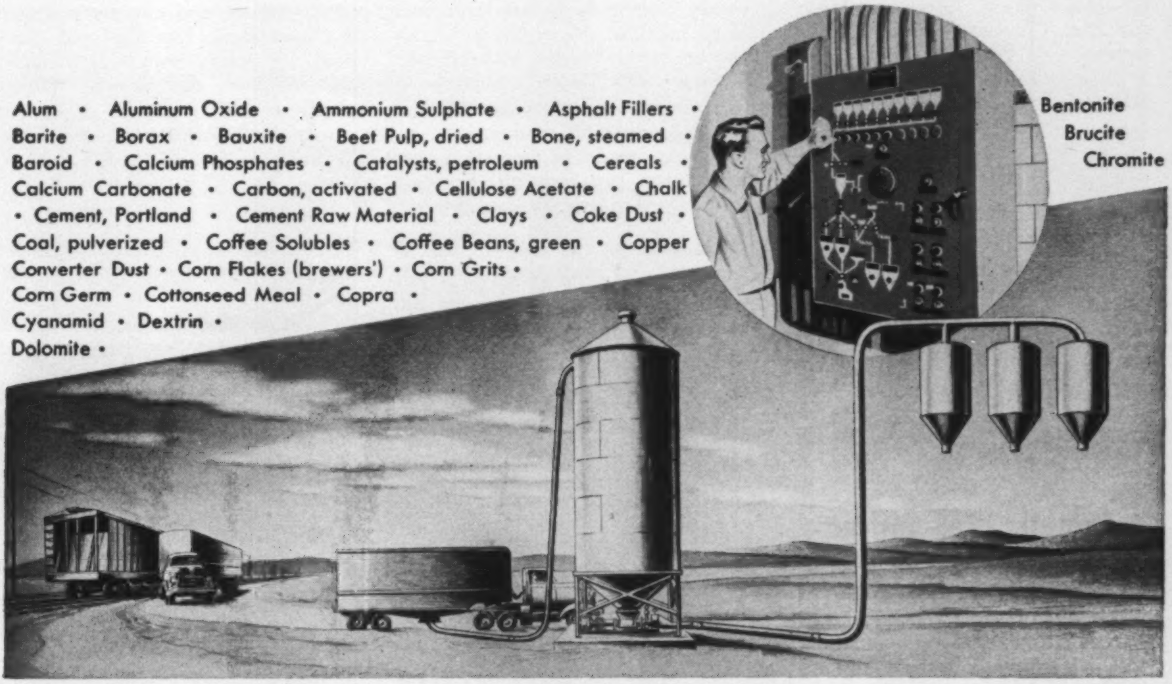
Item 413

Device is suitable in warehouses for handling and storing materials such as boxes, crates, cloth, paper, pipes, bars, packages of sheets and plates, drums, pallets, and tote boxes. Fork lift can be traveled to front, rear, or either side of a building, up, down, and turned through a full circle clockwise or counterclockwise. A flexible control cable permits the worker to operate the unit a safe distance from the load.

Tramrail fork lifts are available for various capacities and lifts. The telescoping type (shown) permits travel over railroad cars and trucks, enabling the handling of materials directly to storage without transferring to other conveyances. The fork lift illustrated is powered with three motors. One propels the unit on a crane bridge, or a two-track runway, driving wheels on both sides by means of a jack shaft. The fork hoist motion is provided by a motor driving heavy chains connecting with the fork and a counterweight. A motor driving a large gear at the top of the unit

Alum • Aluminum Oxide • Ammonium Sulphate • Asphalt Fillers •
Barite • Borax • Bauxite • Beet Pulp, dried • Bone, steamed •
Baroid • Calcium Phosphates • Catalysts, petroleum • Cereals •
Calcium Carbonate • Carbon, activated • Cellulose Acetate • Chalk
• Cement, Portland • Cement Raw Material • Clays • Coke Dust •
Coal, pulverized • Coffee Solubles • Coffee Beans, green • Copper
Converter Dust • Corn Flakes (brewers') • Corn Grits •
Corn Germ • Cottonseed Meal • Copra •
Cyanamid • Dextrin •
Dolomite •

Bentonite
Brucite
Chromite



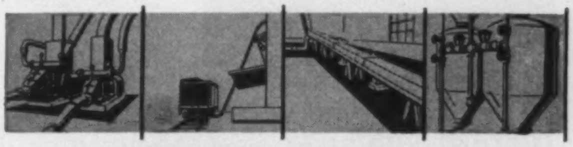
Diatomaceous Earth • Feed Ingredients • Feeds, soft • Feldspar • Fertilizers • Flaxseed • Flue Dusts • Fluorspar
Flour • Fly Ash • Fuller's Earth • Gluten Meal • Gypsum (raw or calcined) • Grains • Ilmenite • Iron Salts • Litharge
Lime, pebble • Lime, hydrated • Limestone, pulverized • Magnesite • Magnesium Oxide • Manganese Dioxide •
Milk, dried • Nylon Pellets • Phosphate Rock, pulverized • Polyethylene • Pyrites • Quartz, pulverized • Rubber Pellets •
Resins, synthetic • Salt Cake • Shells, pulverized • Semolina • Talc • Wood Chips • Wood Flour • Zinc Oxide

CONVEY MANY DRY BULK MATERIALS BY AIR

Automatically

Conveying of dry bulk materials can be accomplished automatically—by air—with Fuller systems. Dollar losses, formerly conceded to be "natural" incidents of conveying, are now being chalked up as new savings. Fuller systems are designed for minimum maintenance . . . completely enclosed for sanitary transportation from carrier to storage to process without spillage. Installation is possible anywhere pipelines can be run without changing plant structures or interrupting production.

If you use dry bulk materials, investigate the possibilities of profiting with Fuller. Write for Bulletin G-2, "How to Pull Dollars Out of Thin Air."



FULLER COMPANY GENERAL AMERICAN

G-139
3676

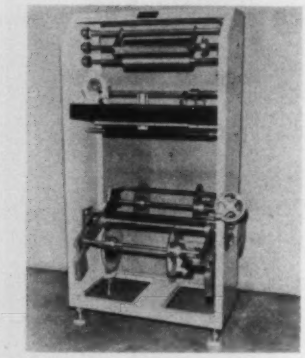
Fuller
pioneers in harnessing AIR

FULLER COMPANY
162 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Chicago • San Francisco • Los Angeles • Seattle • Kansas City • Birmingham

Circle 690 on Page 17

provides rotation. **Cleveland Tramrail Div., Cleveland Crane & Engineering Co.,** Wickliffe, Ohio.

Circle 413 on Page 17

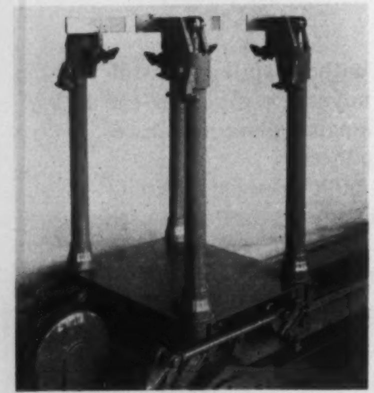


Automatic Web Splicer

Item 414

Suitable for use by food processors, frozen food plants, bakeries, and bag converters, automatic web splicer integrates with overwrap machines and attaches, by splicing, a new roll of wrapping material to the depleting roll at the last full-printed panel. Splicer feeds wrapper rolls in a continuous flow with precision registration. Speed is 15 to 160 lineal fpm. Sprocket and chain drive is connected to the wrapping machine in a 1 to 1 ratio. Sprocket drive is adaptable to inside or outside of web frame; drive is clockwise or counterclockwise. **Butler Automatic Machine Inc.,** Box 391, New Canaan, Conn.

Circle 414 on Page 17



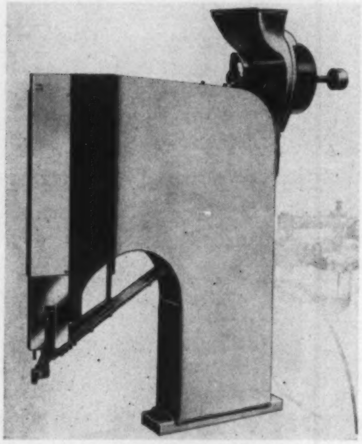
Transfer Unit

Item 415

Device is adaptable to transfer parts from conveyor hook to machine, from belt to machine, and from machine to machine. Unit can be operated either hydraulically or electrically; hydraulic power is used for short carriage strokes, and electric for longer strokes.

In one mode of operation, the mechanism can pick up the work from two conveyor hooks and transfer it to workcarrier hooks. The finished work can then be moved into place on the conveyor. The finished work is then indexed out of the conveyor loading station, the unfinished work moved into its place, and the cycle repeated. **Equipment Div., Wagner Bros. Inc.,** 7800 Dix Rd., Detroit, Mich.

Circle 415 on Page 17



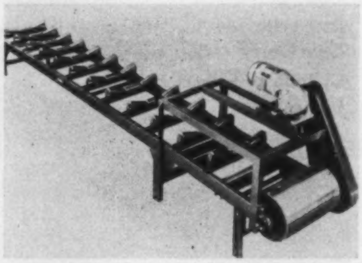
Pneumatic Riveter

Item 416

Bench-type unit can be used in conjunction with in-line slide fixtures or rotary transfer tables for progressive, high-speed production assembly operations. Model 56 is actuated by a pneumatic cylinder which drives the setting tool through a toggle linkage. It will operate from shop air from 60 to 150 psi. Cycling speed at the high end is limited only by the rate at which the rivets drop from the feed rail into the jaws. Speed of the stroke can be adjusted to control the impact on fragile materials such as plastics and porcelain.

When equipped with quick-change raceways, the machine can set tubular steel rivets ranging from 0.058-inch up to 5/32-inch diameter, and from 3/32-inch up to 3/4-inch in length. Unit is controlled by solenoid actuated pneumatic valves, and can be arranged for automatic cycling and part feed. A rotary hopper is included as standard equipment. Throat depth of the riveter is 9 inches; stroke is 2 inches. **Milford Rivet & Machine Co.,** Milford, Conn.

Circle 416 on Page 17

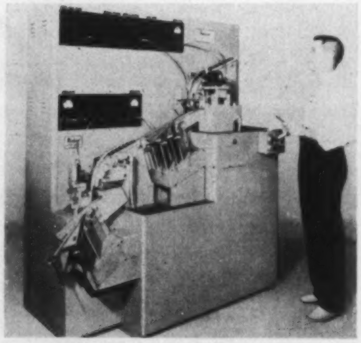


Troughing Belt Conveyor

Item 417

Unit is capable of handling scrap from punch presses and other bulky materials. Belt is made of rubber, Neoprene or canvas, depending on the application. Roller is a standard type, 2 inches in diameter. Ball bearings are grease-packed and equipped with a Neoprene seal. Conveyors are offered complete or in part, are available in 18 and 24-inch widths. **Sage Equipment Co. Inc.,** 30 Essex St., Buffalo 13, N. Y.

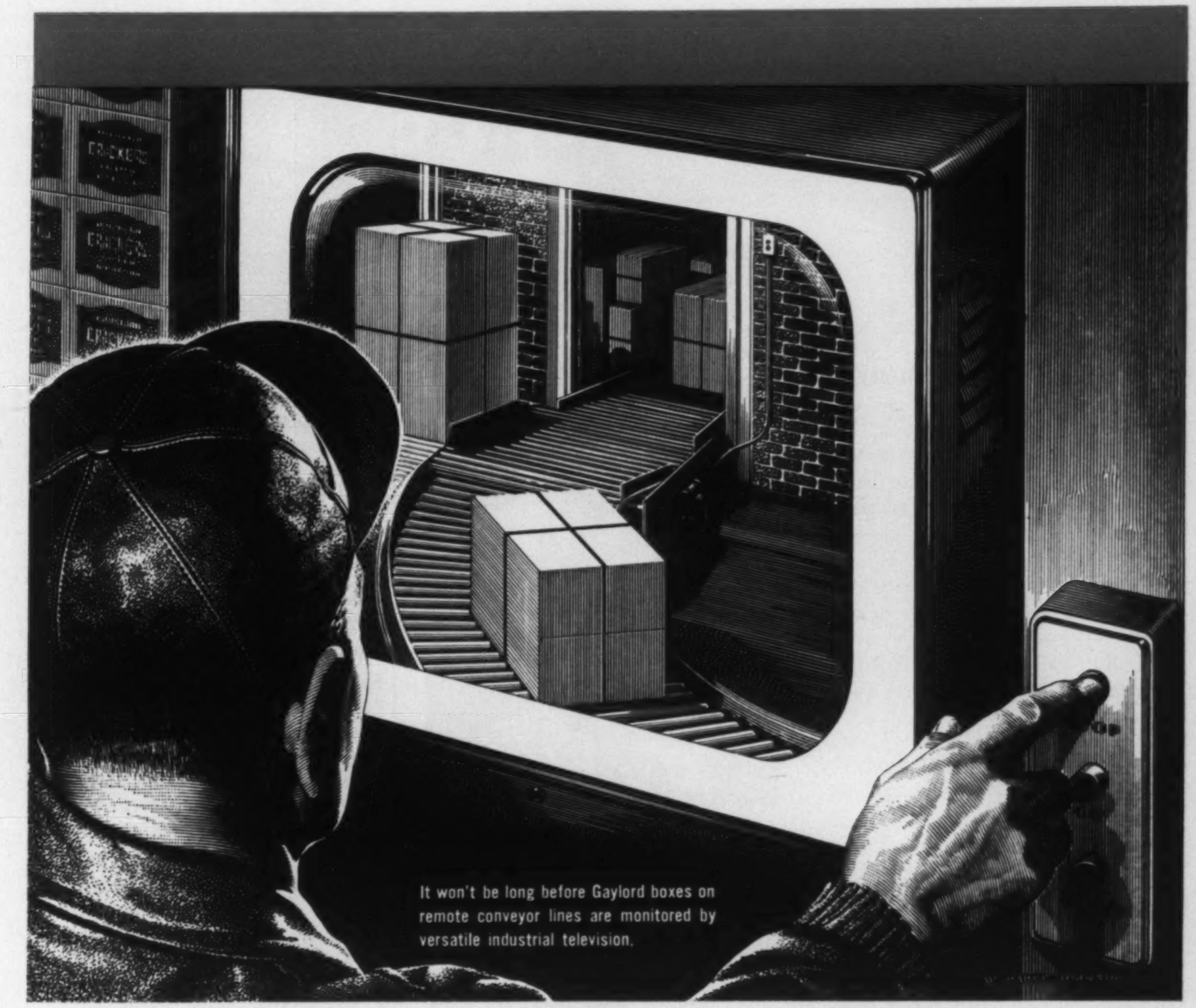
Circle 417 on Page 17



Valve Inspection Machine

Item 418

Device automatically checks concentricity of engine valve seat and stem, valve straightness, head thickness and over-all valve length at a production rate of over 3000 pieces per hour. The seat and stem concentricity check is independent of the size of the valve. Machine is controlled electronically. It receives



It won't be long before Gaylord boxes on remote conveyor lines are monitored by versatile industrial television.

WELL-BEHAVED BOXES...

Gaylord Boxes

...are vital to modern, mechanized handling methods. As operations become more automatic, interruptions are more costly. Precision-built Gaylord containers are dimensionally accurate and structurally strong to speed packing and handling...prevent jam-ups.

Gaylord container specialists will be glad to work with you in selecting or developing "well-behaved boxes"... for maximum manpower-saving efficiency. Call your nearby Gaylord office.

CORRUGATED AND SOLID FIBRE BOXES • FOLDING CARTONS • KRAFT PAPER AND SPECIALTIES • KRAFT BAGS AND SACKS

GAYLORD CONTAINER CORPORATION ★ ST. LOUIS

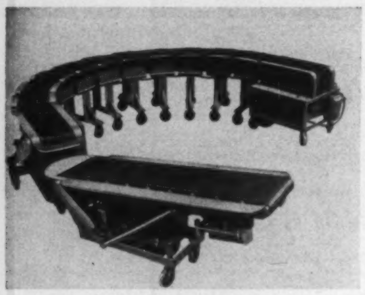
DIVISION OF CROWN ZELLERBACH CORPORATION

signals from the compact inspection gage heads regarding concentricity, straightness, thickness, and length, and stores this information and relates it to solenoid controlled gates in segregation chutes. After inspection, the valve is directed to the proper *Rejection* or *Pass* chute.

Accurate and compact gage heads are used to check valve dimensions. Gage heads do not have any bearings, gears, racks, magnets, or coils, but operate on a reflected-wave circuit using a frequency of 30 mcps. They can operate to 0.000001-inch constantly with 100 per cent repeatability. The electronic circuit, of plug-in design, is divided into packaged units which can be removed for inspection or replacement.

Valves are fed to the machine from a hopper which is equipped with an elevator and horizontal conveyor. Each has separate motors, gear reducers, and controls which feed the valves at a continuous oriented flow at the required speed. A master valve is not required to set up the concentricity check; only the approximate size of the valve is needed to permit setting up concentricity limits on the gage. **Arlin Products Inc.**, 13541 Auburn Ave., Detroit 23, Mich.

Circle 418 on Page 17



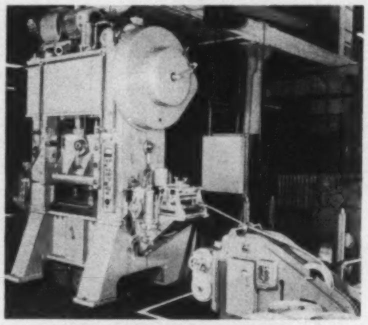
Conveyor/Stacker

Item 419

Electrically powered, portable conveyor and stacker is pushbutton controlled. Unit can bend horizontally in either direction to mechanically carry materials around stationary objects. It can easily be moved from one location to another, and is convenient for short run handling assignments such as loading and unloading boxcars and trucks. Device includes a power stacker car, belt drive car, power traveler car, and any number of center cars, depending on individual needs.

A six foot boom can swing 90 degrees to the right or left, has a rubber-grip-belt designed to carry materials without slipping when the boom is elevated at sharp angles. The power traveler car has an electric motor that is pushbutton controlled to provide power for forward and reverse travel of the entire conveyor and stacker. The belt is available in widths of 12 and 18 inches. **Jervis B. Webb Co.**, 8951 Alpine Ave., Detroit 4, Mich.

Circle 419 on Page 17



Straight Side Press

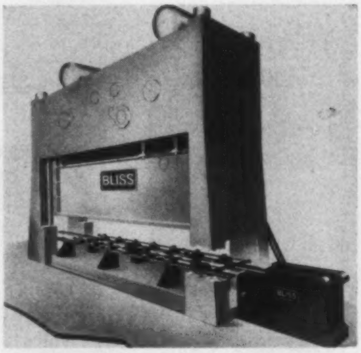
Item 420

Unit has an automatic coil feed, is designed to perform blanking, forming, drawing, and perforating operations in long or short runs. The drive mechanism is of heavy construction for high speed and continuous operation. The automatic feed allows coil stock to be fed at speeds up to 100 fpm. A roll-lifting system is built into the press for independent, infinite adjustment of ingoing-outgoing rolls from floor level. An electro-pneumatic friction clutch operates directly on the crankshaft. An automatic circulating oil system keeps every bearing surface properly lubricated at all times. **Niagara Machine & Tool Works**, 683 Northland Ave., Buffalo 11, N. Y.

Circle 420 on Page 17

Portable Transfer Feed

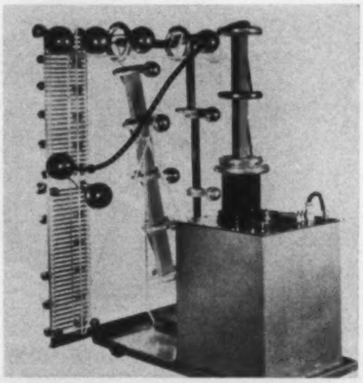
Item 421



Self-contained transfer feed console can convert straight side presses to automatic transfer feed drive operation. Operated through one power take-off from the press crank, or independently powered and set up to control the press cycle, transfer mechanism can also be used to move material through a series of presses.

In operation, aluminum feed rails are driven from right to left, and can be used to push or pull work through the press. Transfer fingers, attached to pivoted arms or rack and pinion fingers on the feed rail, are actuated through linkages to the same drive source as the rails. Feed stroke is adjustable from 15 to 30 inches in increments of one inch. Light feed rails can be removed without disturbing die settings by removing the splice plate bolts and breaking the quick disconnect on the arm actuating rod. When a part is misfed, interlocks in each finger stop the press and feed. Other interlocks prevent the rails from moving while the fingers are feeding. **Press Div., E. W. Bliss Co.**, Canton, Ohio.

Circle 421 on Page 17



High Voltage Supply

Item 422

Model 4250-2 is an air-insulated selenium-rectified 250kv, 2ma pow-

LONGER SOLENOID LIFE...

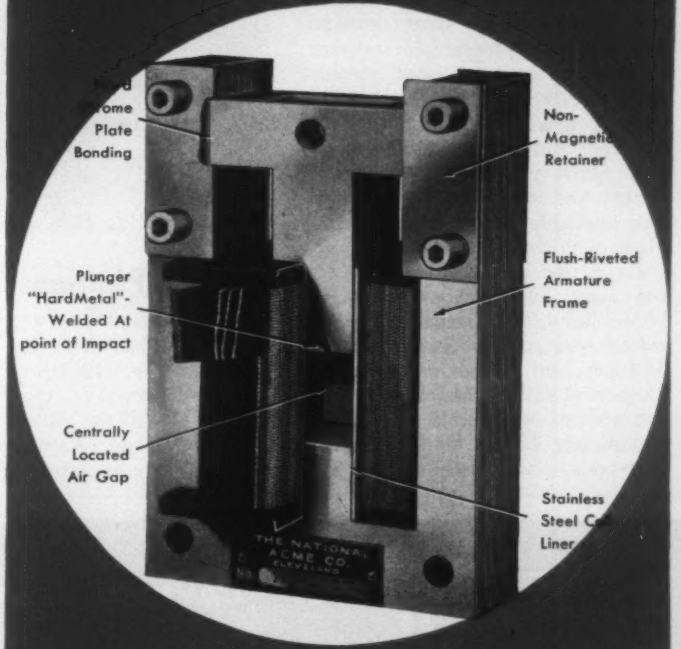
with NAMCO'S exclusive "HARDMETAL"-welded plunger bonding

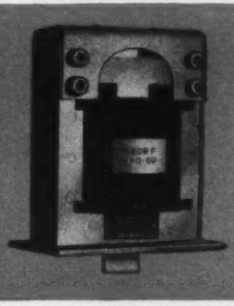
Standard or Custom Models To Fit Your Design

"HardMetal"-welded plunger bonding prevents mushrooming at the vital point of impact—withstands incessant pounding of the plunger on the frame. Long plunger life, and thus long solenoid life, is further insured by hard chrome plating upper guide edges of plunger laminations to reduce friction and wear.

Namco standard solenoids are available in six series of pull and push type; custom-engineered solenoids in every size and type can be made to meet your specifications.

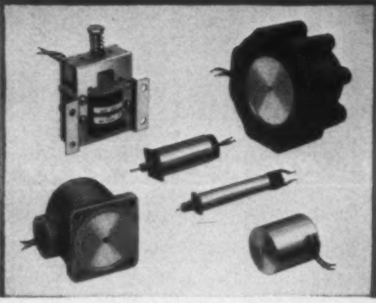
Standard "HardMetal"-Welded Solenoids are furnished push or pull type in sizes with ratings from 2-1/2 to 21 pounds at 1/2" stroke and from 2 to 25 pounds at 1" stroke.


rome
Plate
Bonding
Non-
Magneti
Retainer
Flush-Riveted
Armature
Frame
Plunger
"HardMetal"-
Welded At
point of Impact
Centrally
Located
Air Gap
Stainless
Steel C
Liner
THE NATIONAL
ACME CO.
CLEVELAND



← Saddle stop applied to Series K200 standard Namco push type solenoid.

To meet specific job requirements, solenoids of special shapes and sizes are designed and built through cooperation of our engineers with yours. →



Ask us to send a National Acme Representative to discuss your problems, or if you want more information first—send for BULLETIN EM-52.

ELECTRICAL MANUFACTURING DIVISION

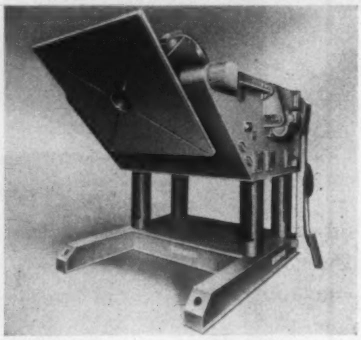
National Acme

THE NATIONAL ACME COMPANY, 196 EAST 131ST STREET, CLEVELAND 8, OHIO

er supply. Instrument has an input voltage of 105 to 125v, 50 to 60 cycles, single phase. Input power is approximately 1kva. Features include continuously variable output voltage, manually reversible polarity, approximately 2.5 per cent ripple at maximum rated power output, internal impedance of 11 ohms, 0-250kv voltmeter and 0-5 microammeter.

Protective features include provision for external safety interlock, zero start interlock, fixed overcurrent and overvoltage relays preset for 110 per cent of rated output, short circuit surge current-limiting resistor, gaseous discharge devices for protection of relays and meters, and spark gap to ground from meters and transformer primaries. Also available is a line voltage regulator which stabilizes output to 1.5 per cent for line changes of ± 12 per cent; 220v, 60 cycle, single phase input; fine control of high voltage output to approximately 0.03 per cent of maximum; triple-range load current and output voltage meters with scale ratios approximately 1 to 3 to 10; overcurrent relay with trip adjustable from 20 to 120 per cent of rated current; and overvoltage relay with trip adjustable from 10 to 115 per cent of rated voltage. **Beta Electric, Div. of Sorensen & Co. Inc.**, 333 E. 103 St., New York 29, N. Y.

Circle 422 on Page 17



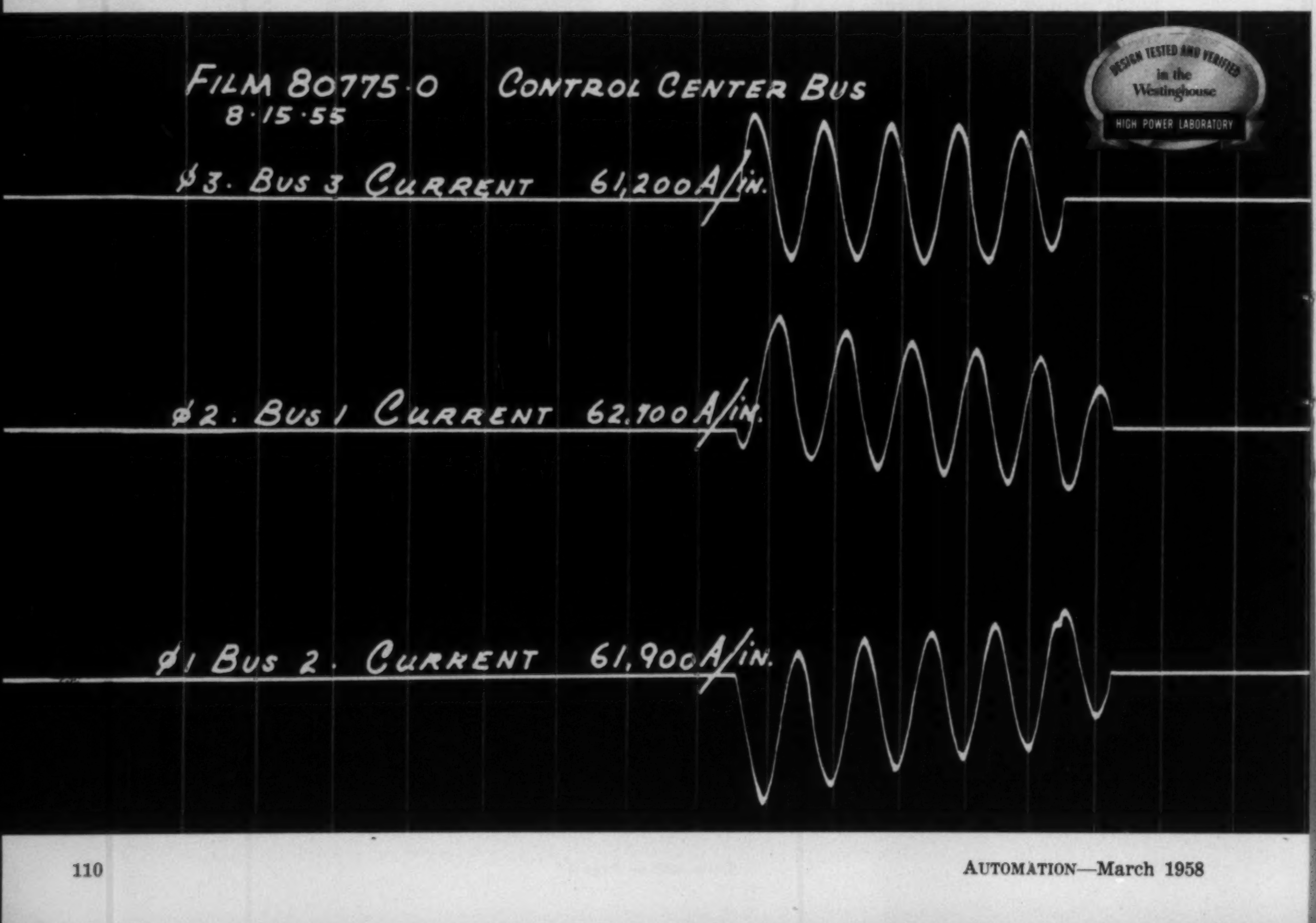
Welding Positioner

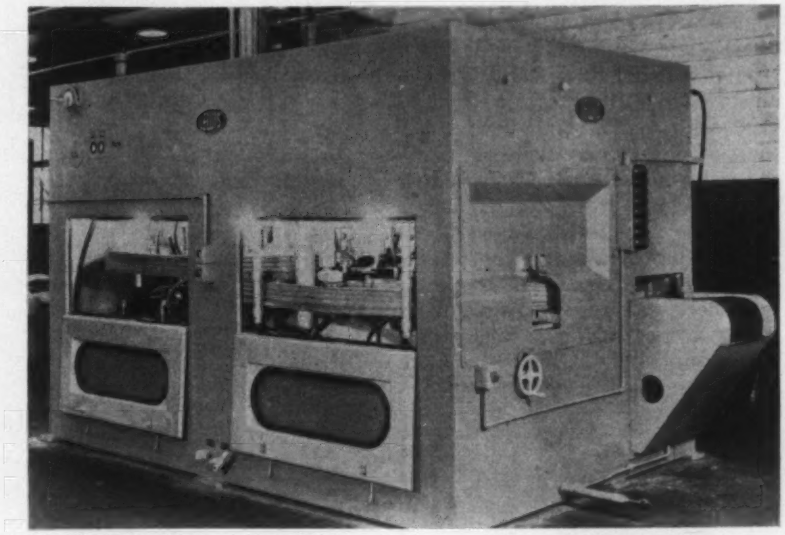
Item 423

Machine has a weight capacity of 25,000 lb with the center of gravity location of the work 12 inches above the table and 12 inches off-center. Raising and lowering are accomplished with a 4-post elevator base having 10-inch OD by 1-inch wall seamless tubes with spur rack teeth. Each post has four concave rollers to maintain rigidity and steadiness of the chassis while elevating. All elevator mechanisms are contained inside the chassis. A 10 hp brake motor powers torque tubes through two wormgear reducers to effect elevation of the chassis. Adjustable stops and precision limit switches effect accurate lift setup and prevent chassis from overriding its columns.

Model GE250 has a 4-speed transmission with speeds of 0.76 to 0.11 rpm in high gear allowing rapid positioning; 0.38 to 0.05 rpm in third gear for large weldments and average weld speeds; 0.26 to 0.034 rpm in second gear for larger weldments and slower weld speeds; and 0.19 to 0.025 rpm in low gear for largest weldments and slowest weld speeds. A 9 inch through-hole spindle allows access for mounting air cylinders, weldments with hubs or axles, or for piping gases. **Aronson Machine Co.**, Arcade, N. Y.

Circle 423 on Page 17





Liquid Abrasive Unit

Item 424

Machine uses a liquid abrasive process to give a microscopically smooth finish to aircraft, missile, and automotive components. It is suitable for removing heat treatment scale, rust, and other undesirable surface conditions from parts. It may also be used to improve the quality of the surface and give a clean, smooth texture for subsequent plating or other final finishing procedures.

An oscillating air blasting gun which is fed by a variable displacement pump handles different sized components by means of two interlocking sets of moving rubber belts. The piece to be finished is grasped between the first set of belts in such a way as to permit most of the surface to be exposed to the high pressure spray from the oscillating gun. As the first part of the cycle is completed, the second set of belts picks up the piece on its finished portion and carries it through a second spray area. After the blasting operations are completed, the pieces pass through a rinse compartment where the sand particles are completely removed. The rubber belts grasp the piece with enough force to hold it rigidly without damaging the surface of the metal or distorting the inherent shape, and the double set of belts permits one continuous surface finishing operation.

The abrasive materials used in the process vary widely, but are usually finely divided particles held in suspension in a liquid medium. The particles vary in size from the consistency of a very coarse sand to extremely finely divided particles. The fluid is usually water. The air nozzle and the water nozzle are so mounted in the gun body that their relative positions can be

Westinghouse CONTROL CENTER design tested at 25,000 amperes to insure safety for personnel and equipment

At the Westinghouse High Power Laboratory, the new Westinghouse Control Center design has been thoroughly tested under maximum fault conditions with no damage to equipment . . . conclusively proving it industry's safest control center.

With complete interchangeability between 9⅓-and 14-inch modular units, simplified installation and increased safety, Westinghouse Control Centers make possible the most compact, economical, centralized control systems.

For complete information on the Westinghouse Control Center, call your Westinghouse sales engineer, or write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa.

J-22102

POWER-UP starts with CONTROL

YOU CAN BE SURE...IF IT'S Westinghouse

ATTEND THE
1958
ASTE
TOOL SHOW
CONVENTION CENTER
PHILADELPHIA MAY 1-8

SEE all the very latest advances and improvements in more than thirty major categories of industrial products.

ATTEND top-level conferences, conducted by recognized authorities on the newest production techniques and developments.

MEET and exchange ideas with management, engineering, production, sales people from the nation's leading industrial concerns.

INSPECT the modern equipment and up-to-the minute manufacturing methods being utilized in booming Delaware Valley plants.

AMERICAN SOCIETY
TOOL SHOW
CONFERENCE
'58
MAY 1 TO 8
OF TOOL ENGINEERS

Circle 694 on Page 17

adjusted. The size of each nozzle can be selected for the particular type of material to be blasted, the air pressure can be regulated independently of the slurry flow, and the volume of slurry flowing from the water nozzle can be independently regulated at the slurry pump. Satisfactory results have been obtained using this process on materials such has aluminum, copper, mild steel, stainless steel, and titanium. **Lewis Welding & Engineering Corp.,** Bedford, Ohio.

Circle 424 on Page 17

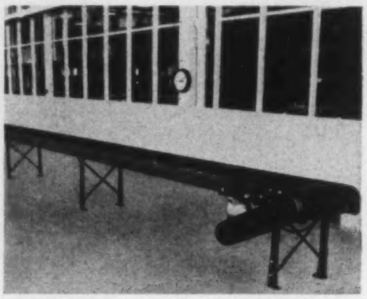
Alternator Controller

Item 425

Unit is suitable for use with standard inductor type alternators ranging from ¾ kva to 30 kva, 3 ph, and from ¾ kva to 15 kva, 1 ph. Alternators are regulated by either an electric or magnetic amplifier exciter regulator. An input transformer provides regulator operations from line voltage. Automatic voltage control and an overvoltage relay in the output circuit protects the load from excessive voltages.

Motor *Start-Stop* pushbutton stations with an indicator lamp are wired to the control transformer, which removes regulator power during shutdown, reducing regulator burnouts. Accessories are available in two combinations; Group B includes an ammeter, voltmeter, frequency meter, and an ammeter-voltmeter selector switch for 3 phase alternator sets; Group C includes an output circuit breaker in the control cabinet with a combination magnetic starter mounted on the base of the set. **Electric Machinery & Equipment Div., American Electronics Inc.,** 655 W. Washington Blvd., Los Angeles 15, Calif.

Circle 425 on Page 17

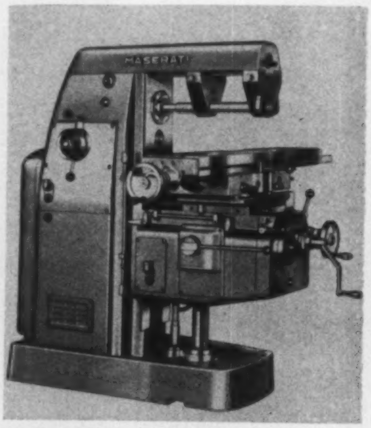


Power Belt Conveyor

Item 426

Line of package handling power belt conveyors is designed for simplified assembly, using hand tools. Two types are available: Model 536 (shown) has a slider bed, and Model 538 has a roller bed. The slider bed conveyor can be powered to handle loads up to 75 lb per ft when installed horizontally with supports on standard ten-foot centers. When installed in an inclined position, conveyor has a load capacity of 50 lb per ft. Roller bed conveyor can be powered to handle loads up to 100 lb per ft in horizontal service. **Conveyor Dept., A. B. Farquhar Div., Oliver Corp.,** 156 N. Duke St., York, Pa.

Circle 426 on Page 17



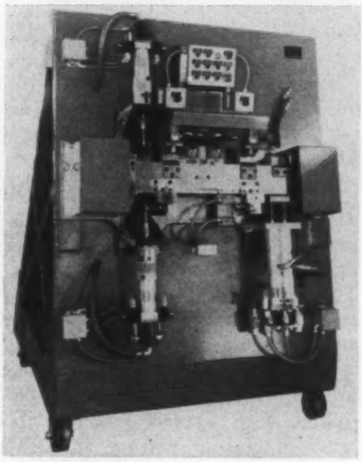
Milling Machine

Item 427

Unit has two ranges of 12 spindle speeds, either from 36 to 1500 rpm or from 43 to 1800 rpm. Drive from the main motor is transmitted by means of 4 Vee-belts to the main shaft on the spindle gear box. An electromagnetic brake mounted on the main shaft provides rapid stopping of the spindle. The dial on the spindle speed selection has a pushbutton for intermittent control of the motor to make the meshing of the gears easier.

The whole unit is controlled from an electric panel on the front of the machine. Spindle and knee motor are controlled by a lever on the side of the machine. When this lever is pushed down, both motors are started unless a disconnection switch on the control panel has disconnected the knee motor. Lubrication is provided by a reversible gear pump for the spindle and gear box and by another gear pump for the knee and feed box. **Maserati Corp. of America,** 46 Sea Cliff Ave., Glen Cove, Long Island, N. Y.

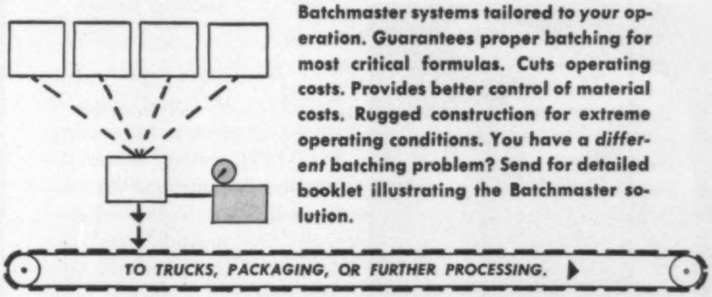
Circle 427 on Page 17



Automatic Drill Unit

Item 428

Machine drills and countersinks six holes in right and left hand diecast radiator grilles. An automatic indexing selector is controlled by a panel of 18 relays working with 12 signaling limit switches. The pushbutton control panel includes *Start* and *Stop,* and three-position *Off, Manual,* and *Automatic* switches. Separate pushbutton switches individually operate each drill unit, index the slide, or actuate the clamp members for ma-


TO TRUCKS, PACKAGING, OR FURTHER PROCESSING.

PUSH BUTTON BATCHING

BATCHMASTER speeds automatic processing

At last, completely automatic one-man batching for you. Batchmaster is the simple, speedy system for precise mixing of multiple ingredients to any desired formula. Accommodates all materials — solid, powdered, granulated, liquid. Provides *continuous* automatic control of all ingredients by weight. Boosts production, improves quality control, eliminates waste.

No need for expensive, complex custom installations. Howe engineers *standard* Batchmaster systems tailored to your operation. Guarantees proper batching for most critical formulas. Cuts operating costs. Provides better control of material costs. Rugged construction for extreme operating conditions. You have a *different* batching problem? Send for detailed booklet illustrating the Batchmaster solution.

Simply dial the formula and mixing times, select number of batches, and press start button. Any number of ingredients are automatically fed, weighed, mixed and discharged.

Write for Complete Details

HOWE

THE HOWE SCALE CO. • RUTLAND, VERMONT
A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

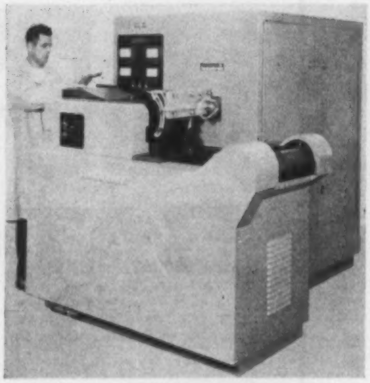
Circle 695 on Page 17

chine alignment or adjustments.

In operation, the grille is placed in the holding fixture which is secured to the indexing slide. Two *Cycle Start* buttons are pressed. This energizes the circuit that closes four air-operated clamps to hold the grille firmly in position. After clamping, a limit switch closes, causing a double-acting air cylinder to index slide and grille into the first work position. Then a limit switch closes, signaling drill-units 1, 2, and 3 to advance and drill-countersink holes, and automatically retract when the work is completed.

After retraction, the series-connected limit switches close a circuit causing the slide to index back to the original *Start* position. As the slide returns to this position, a circuit is energized and drill units 1, 2, and 4 drill-countersink holes at this setting, then retract to rest position. The work piece clamps open, allowing the grille to be removed from the fixture. **J. C. Thompson Tool & Die Inc.**, 3000 Engle Rd., Fort Wayne, Ind.

Circle 428 on Page 17



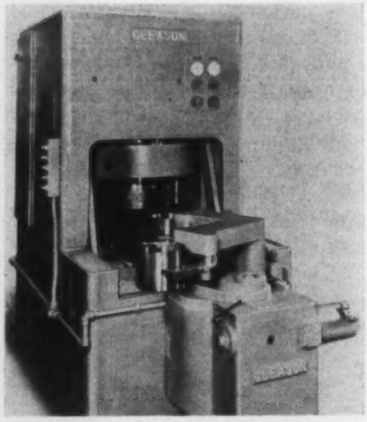
Induction Heating Unit

Item 429

Designed for the rapid selective hardening of parts on a high production basis, machine is also suitable for a wide range of high frequency induction heating applications such as annealing, brazing, soldering, tempering, and shrink fitting. In operation, parts are loaded by hand into a magazine type loading fixture which in turn automatically loads them into notches in the periphery of a rotating drum type fixture. As the parts are carried around by the drum, their ends are passed through an arc-shaped high frequency heating coil which heats them by induction. Parts drop from the drum by gravity into the quench tank directly below, and a conveyor in the tank delivers the finished parts to a receptacle at the side of the machine.

Safety features include cabinet door safety switches, fast acting circuit breaker, protective controls for water flow and temperature on water cooled units. **Process Machinery Div., Cincinnati Milling Machine Co.**, Cincinnati, Ohio.

Circle 429 on Page 17



Loader/Unloader

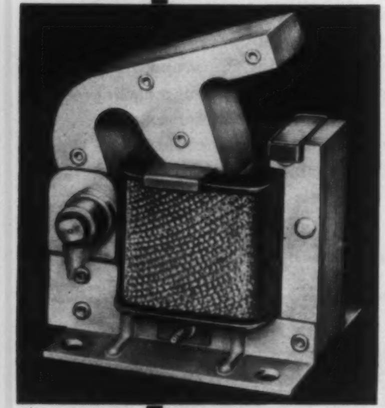
Item 430

Developed for company's quenching presses, loader and unloader mechanism is completely automatic. The unit attaches on the front of the quenching press and is timed in conjunction with the quenching cycle of the press. The load and unload mechanism is cam controlled, with a plate indexing the arms of the unit from the load to unload position. The arms are at 90 degrees to each other; one arm completes the loading action, and the other simultaneously completes the unloading.

In the first phase of operation, when the lower die of the quenching press is in the forward position, the part to be quenched is delivered from the furnace under the load arm of the unit. The arms of the load and unload mechanism lower, and the adjustable jaws of the load arm close on the part. Holding the part, the arms raise and rotate 90 degrees and lower over the die, releasing the

ROTOSOL®
(Simplified Rotary Action)
Solenoid

for split second action



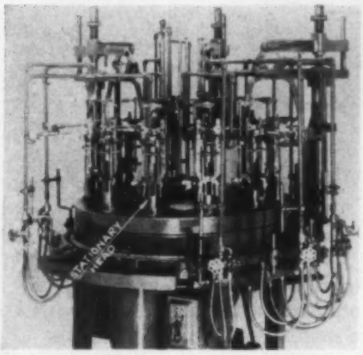
You can reduce your manufacturing costs and improve your product by using ROTOSOL rotary action solenoids. Applications are unlimited. Sturdy construction—Only one moving part—operates AC any direction. Our engineers will cooperate with designers, provide engineering data and cost information on request.

ROTO MANUFACTURING COMPANY
1030 West Second Street • Xenia, Ohio

Circle 696 on Page 17

part in the proper position. The lower die of the quenching press swings in to quenching position, and the arms rotate 90 degrees back to the original position. At the end of the preset quenching cycle, the lower die of the quenching press swings out to the unload position. As subsequent parts are received from the furnace, the same sequence occurs, except that both loading and unloading occur. When the quenched part is ready for removal, both arms lower, and the adjustable jaws simultaneously clamp the parts. The arms raise and are rotated 90 degrees. The arms lower and the jaws open, releasing the quenched part in the receiving tote basket, and depositing the part to be quenched onto the lower quenching die. **Gleason Works,** 1000 University Ave., Rochester 3, N. Y.

Circle 430 on Page 17



Glass Bulb Stemmer

Item 431

Unit is capable of making stems for the radio tube and incandescent lamp industry. Model 23-12TU has three press positions, each one individually adjusted. As the exhaust tube goes through the stem press it is kept open by means of a pin moving in and out while the glass is plastic. Hard and soft glass stems can be made on this unit. On larger tubes, a number of heats are necessary, and an additional number of press positions are supplied to make a good press. A clamping arrangement may be attached to the machine. Setup shown can index 400 to 500 stems per hour. **Eisler Engineering Co. Inc.,** 750 So. 13th St., Newark 3, N. J.

Circle 431 on Page 17

System of belt-driven type Logan Live Roller Conveyors in wholesale drug warehouse. Out-going orders are automatically shunted to proper spur line by electrically operated deflectors controlled from dispatcher station through selective switching panel.

SALES begin in the SHOP!

Today, your "man in the field" needs every advantage that you can give him — particularly a favorable price. Cost studies show that the selling edge is often a *price edge* that begins on the production line. That's why management is turning more and more to materials handling in its quest for economy.

Soundly engineered Logan Conveyors have brought savings in time, effort and space to companies large and small for half a century. Perhaps Logan's experienced engineering personnel and time-tested equipment can provide that vital edge in the market place for you, too. Write for literature, or for nearest engineer to call.

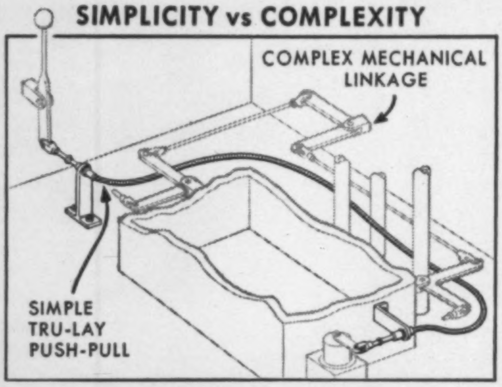
LOGAN CO., 218 CABEL ST., LOUISVILLE 6, KY.

Logan Conveyors

Circle 697 on Page 17

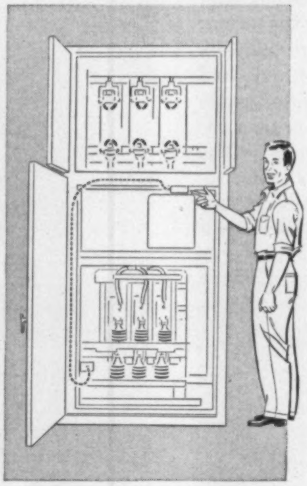
Design Engineers find PUSH-PULL Controls eliminate complicated mechanical linkages

SIMPLICITY vs COMPLEXITY



Compare the TRU-LAY PUSH-PULL cable in the illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts and wear at many points. Their use brings increasing backlash, lost accuracy and vibration.

USED AS A DOOR INTERLOCK IN HIGH-VOLTAGE CABINET



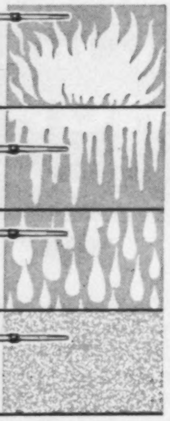
TRU-LAY PUSH-PULL cable insures high-voltage load is OFF before door can be opened.

Saves Space because it is flexible as a wire rope and fits easily into limited space.

Easy to Install with a simple clip where loads are light—clamped at the conduit fittings with a machined bracket.

Economical because it requires no maintenance. We have never known a TRU-LAY PUSH-PULL to wear out in normal use.

VERSATILE TO MEET THE TOUGH JOBS



HOT JOBS TRU-LAY PUSH-PULLS will function under high temperatures. Are ideal controls for jet aircraft and industrial furnaces.

COLD JOBS TRU-LAY PUSH-PULLS will function accurately in cold as low as —70°F.

WET JOBS TRU-LAY PUSH-PULLS are highly water-resistant by virtue of their construction.

ABRASIVE JOBS TRU-LAY PUSH-PULL cables can be completely rubber-covered for extra protection.

TRU-LAY PUSH-PULLS will handle heavy, tough jobs with up to 1000 lbs. input. They are effective controls for remote jobs 150 feet or more from the control point. They are frequently and successfully used in conjunction with electric, hydraulic and pneumatic controls.

CHECK THESE FEATURES AGAINST YOUR REQUIREMENTS

ADAPTABILITY • Approximately 80% of installations are met by standard anchorages, fittings and heads. Simple modifications meet almost every design requirement.

ACCURACY • TRU-LAY PUSH-PULLS are precision-built products. Accuracy is inherent in the basic design and standards of quality.

TROUBLE-FREE • TRU-LAY PUSH-PULLS are sealed against the entrance of dust, dirt or other foreign matter. The inner working member is lubricated for life.

LONG LIFE • Every feature of TRU-LAY PUSH-PULL construction makes these controls strong, highly resistant to stretch and compression, yet extremely flexible. None has ever worn out in normal service.

Push-Pull
DATA FILE

The six bulletins and booklets in the **DATA FILE** *will answer many questions on PUSH-PULLS. Write for your copy.*

ACCO

AUTOMOTIVE and AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

601 Stephenson Bldg., Detroit 2
2216 South Garfield Ave., Los Angeles 22 • 929 Connecticut Ave., Bridgeport 2, Conn.

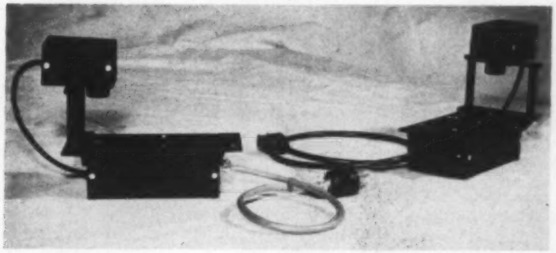
TRADE MARK

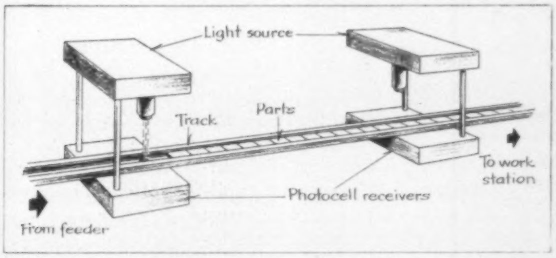
Circle 698 on Page 17

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems

For detailed information and literature, use card page 17.





Control for Small Parts Feeders

A problem usually encountered in the use of small parts feeders is the possible jamming of parts between the feeding device and the machine being fed. This problem is common since the feeding of parts is usually designed to be at a greater rate than the operating speed of the machine.

Equipment which senses the conditions in the track between a feeder and a machine and controls the feeder accordingly has been developed by **Vickers Machine & Tool Inc.**, 1394 E. 22nd St., Columbus 6, Ohio. The device uses two photocell systems positioned at different points on the track. The light beam nearer the machine is blocked by the first part which stops in the control zone between the two light beams. The parts will continue to be fed until the light beam nearer the feeder is also blocked; the track is then full, and the feeding device is shut off. When use of parts by the machine unblocks the light beam nearer the feeder, the other light unit is set to repeat the feeding operation as soon as the parts clear its beam. The system is primarily intended for feeding within the range of 20 to 40 parts per minute.

The sensing units are designed to mount under a typical track section with the light sources supported above the sensing units and the track by posts which straddle the track. Each base unit is $7\frac{1}{4}$ inches long, 3 inches wide, and $2\frac{1}{4}$ inches high. The clearance between the posts which support the light sources is $2\frac{3}{4}$ inches, and the standard clearance height of light sources above the track is 4 inches. For special applications, optical systems with special focal lengths can be furnished to allow greater clearance between the track and the light source. Equipment operates with 110v, 60 cycle current and is rated at 5 amps for plug-in control to primary feeder. External plug-in connections for feeder and sensing units are provided for easy installation.

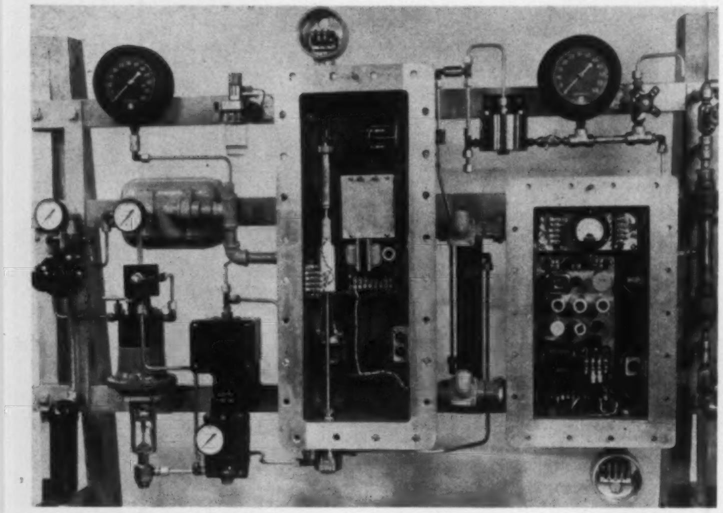
Circle 432 on Page 17

Continuous Vapor Pressure Recorder

Item 433

System is designed to continuously record the vapor pressure of gasolines or liquefied petroleum gases in a moving stream. Instrument includes a sample flow control system, a temperature control system, a liquid level control system, and test circuits for making adjustments during start-up and for routine checks on the performance of major units during operation. Minimum range is 50 psig and maximum range is 750 psig. The minimum spans for these ranges are 8 psig and 115 psig respectively.

In operation, a side stream is taken off the line and enters the top of a self-cleaning filter, passes through the filter, through a flow regulating valve, and back into the line. A shutoff valve is provided on the upstream side of the filter so the filter can be removed for repairs. A filtered sample stream is taken off the side of the filter and a pressure gage is provided so the



upstream pressure can be noted. A shutoff valve in the sample stream isolates the apparatus while adjusting side stream flow through the filter. A fixed flow rate is obtained by maintaining a constant differential pressure of 3 psig across a capillary assembly. The sample stream flows from the filter, through a rotameter which measures the rate of flow, into a heat exchanger column where it is heated to control temperature, and then over a weir tube into the vaporizing chamber. The level control system maintains a constant level so the liquid and vapor have time to reach equilibrium. The equilibrium vapor pressure is detected by a pneumatic pressure transmitter which provides a 3 to 15 psi air signal for the vapor pressure span. The vapor pressure in the liquid line is also indicated on a gage on the apparatus. A vapor bleed valve is connected to the vaporizer to remove noncondensable gases. Unit is rated for 115v, 60 cycles.

Designed by **Shell Development Co.**, Emeryville, Calif., unit is available in two styles. Model 1157 (shown with covers removed) is suitable for use on gasolines and other low pressure hydrocarbons. Model 1158 is used on higher pressures and as an apparatus for indicating proportions of binary mixtures of petroleum gases by a particular vapor pressure. **Hallikainen Instruments**, 1341 Seventh St., Berkeley 10, Calif.

Circle 433 on Page 17

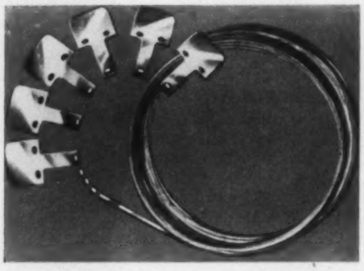
Electronic Tachometer

Item 434

Applicable on conveyors, motors, pumps, machine tools, or other equipment, electronic tachometer provides accurate rotational speed indication. The instrument can measure speeds from 0 to 1000 rpm. The transducer can be mounted in any position and can be installed some distance from the indicating unit. Break-away torque and rotational inertia are negligible.

The transducer contains a light source, a graduated disc and a phototransistor. In operation, the disc is coupled to the shaft whose speed is to be measured. The transducer produces an electrical pulse output which is amplified and shaped in a transistor circuit. These pulses control the charge and discharge of a precision capacitor. The capacitor is charged by a regulated voltage and discharged through a meter calibrated in rpm. The current through the meter is proportional to the frequency of the capacitor discharge. Full scale readings can be changed by switching capacitors in a capacity network which varies the time constant of the circuit. Accuracy is ±1 per cent of full scale. **Southwestern Industrial Electronics Co.**, 2831 Post Oak Rd., Houston 19, Tex.

Circle 434 on Page 17

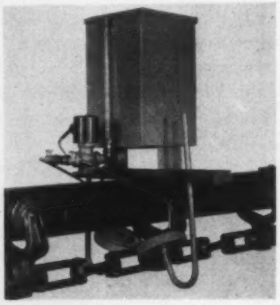


Electrical Contact Tape

Item 435

Tape form makes silver-cadmium oxide clad electrical contact material adaptable to automatic assembly and production of intricate designs, shapes, materials, support, and base metal backings. Tape contact materials are preformed to finished cross-sectional shapes, maintaining these shapes after assembly. Less contact volume is required for electrical and thermal values. For welding applications, contact tapes are supplied with various types of projections. **General Plate Div., Metals & Controls Corp.**, Attleboro, Mass.

Circle 435 on Page 17



Conveyor Oiler

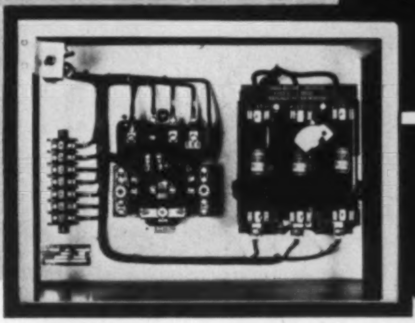
Item 436

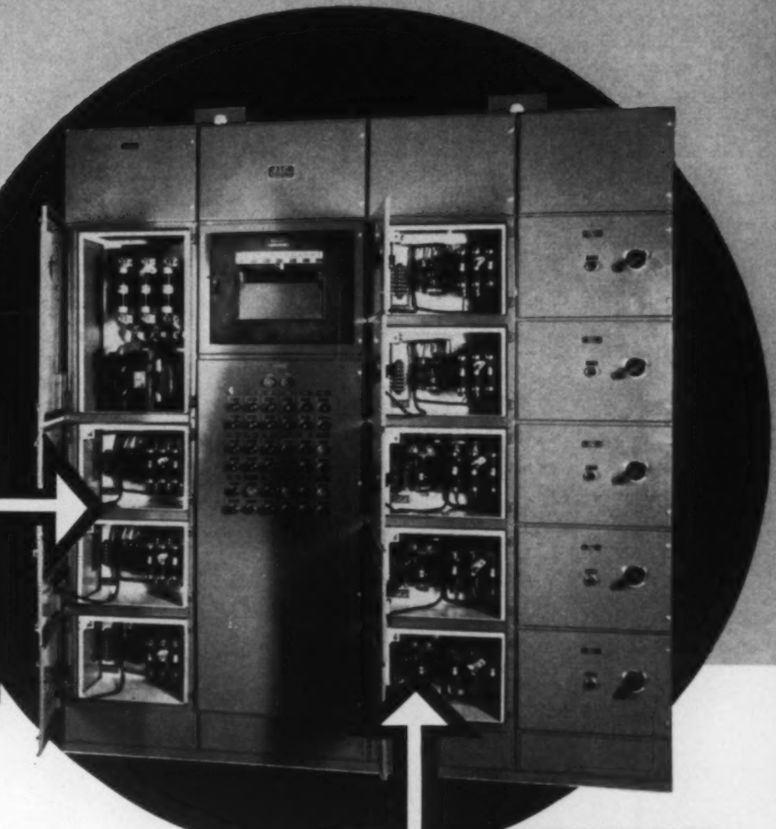
Device applies an even film of oil to conveyor chain links and pins by direct contact of oil-carrying felt rollers. Rollers apply an oil film to each side of top chain simultaneously. They are independently hinged so that equal roll pressure

J·I·C CONTROL CENTERS

Feature "Plug-In" Flexibility

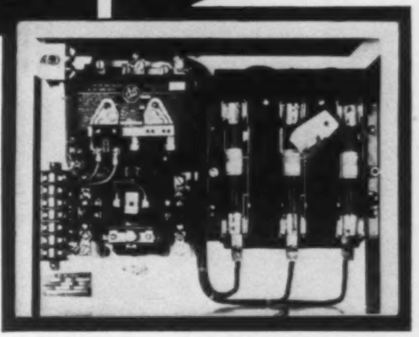
- Unit Design
- Rugged
- Compact
- Greater Safety
- Self Supporting





Central location
Improved efficiency
Reduced maintenance cost

J-I-C control centers are the ideal way to centralize electrical controls for plant operation. All electrical components necessary to control a number of plant functions are contained in uniform cabinets in one location. A variety of plug-in units are available in a combination of fusible switches or circuit breakers, with reversing, non reversing, and multi-speed starters.



J-I-C's Know-How and Experience Saves Money — Improves Product — Speeds Delivery

J.I.C. ENGINEERS ARE SPECIALISTS IN DESIGNING AND BUILDING ELECTRICAL CONTROL PANELS

Our panel men and engineers specialize in designing and building all types of Electrical Control Systems. They will lay out a system to your standards.

A QUOTATION FROM J.I.C. TODAY CAN SAVE YOU TIME AND MONEY

Circle 699 on Page 17

J·I·C
ELECTRIC COMPANY
19255 W. Davison · Detroit 23, Mich.

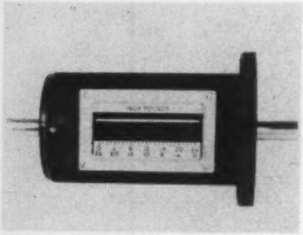
Please send the Bulletins checked below:

☐ Load Switch Bulletin
☐ Special Purpose Electric Controls
☐ Electrical Control Centers

NAME ____________________
COMPANY ____________________
ADDRESS ____________________
CITY ____________ ZONE ________ STATE ________

is maintained despite normal swaying of the conveyor-chain in motion. Roller contact with the chain is effected manually by means of a lever. A solenoid valve automatically starts and stops oil flow as the conveyor starts and stops. Two needle valves directly control the oil flow to each side of chain after solenoid valve is opened. When the conveyor is in motion, each link bearing and pin is oiled every time it passes the oiler device due to the gravity flow of the oil film and the normal chain movement. **Olsen Mfg. Co.,** 638 S. Rochester Rd., Clawson, Mich.

Circle 436 on Page 17



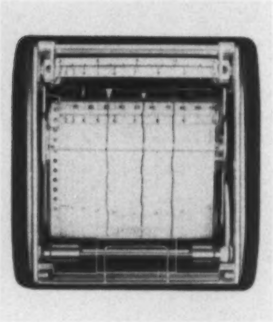
Torque Measurer

Item 437

Device provides an easily read indication of the torque applied to a rotating shaft over a wide range of speeds. Applications include test and inspection of friction brakes, clutches, gear trains, transmissions, motors, and generators.

The unit is inserted by means of flexible couplings between the drive and driven members of the rotating system. Torque applied to the shaft ends of the instrument produces a relative displacement of the shell and drum which exposes the proper calibration marker. This marker, due to persistence of vision, appears as a solid line when the drum and shell are rotated. The position of the line with respect to the edge of the drum is a measure of applied torque. This position is read by means of a scale calibrated directly in torque units and fixed to the outer case of the instrument. Torque range is from zero to 24 in-lb, speed as high as 10,000 rpm. **Fairchild Guided Missiles Div., Fairchild Engine & Airplane Corp.,** Wyandanch, L. I., N. Y.

Circle 437 on Page 17



Panel-Type Recorder

Item 438

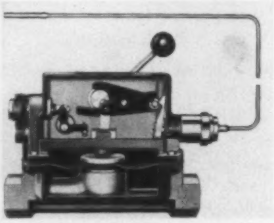
Panel-type instrument offers Batch Stabilog and Auto-Selector control actions as well as proportional, reset, and derivative actions. The Batch Stabilog control permits the use of reset action on batch processes without windup or overshooting at the start of an operating cycle. The Auto-Selector action provides a smooth transfer of reset control selectively for any number of related variables. Recorder can be tilt-mounted and has three pens so that three measurements can be monitored on the same chart. Instrument is equipped with a chart tear-off bar and an automatic-manual switch handle. **Foxboro Co.,** Foxboro, Mass.

Circle 438 on Page 17

Gas Safety Valve

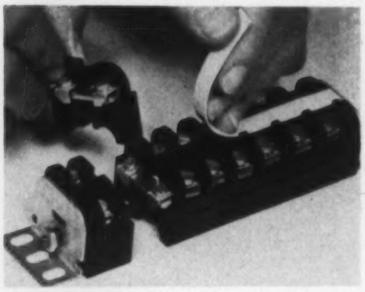
Item 439

Device is operated by a mercury column; provides positive protection in event of pilot failure for emulsion treaters. Valve can be opened only after its mercury actuated element becomes red hot from contact with the pilot flame. If the pilot goes out, the element cools and releases a latch, allowing the valve to snap shut.



A perforated diagram is used to guide the disc to its seat to assure positive closure. Valve cannot be tied open to supply gas to the main burner with the pilot out. Device is available in $\frac{3}{4}$-inch or 1-inch pipe size. **Partlow Corp.,** 504 Campion Rd., New Hartford, N. Y.

Circle 439 on Page 17



Building Block Terminal

Item 440

Snap-in marking strip and snap-on terminal blocks are features of terminal strip design available for custom assembly or in factory assembled strips. Terminals are rated at 600v, ac or dc, 15, 25, and 50 amp. Strips require no special mounting rods, and all three current ratings can be assembled into one mounting strip. Captive wire clamps on open type terminals and pan head screws allow easy wiring. **Gemco Electric Co.,** 25685 W. Eight Mile Rd., Detroit 40, Mich.

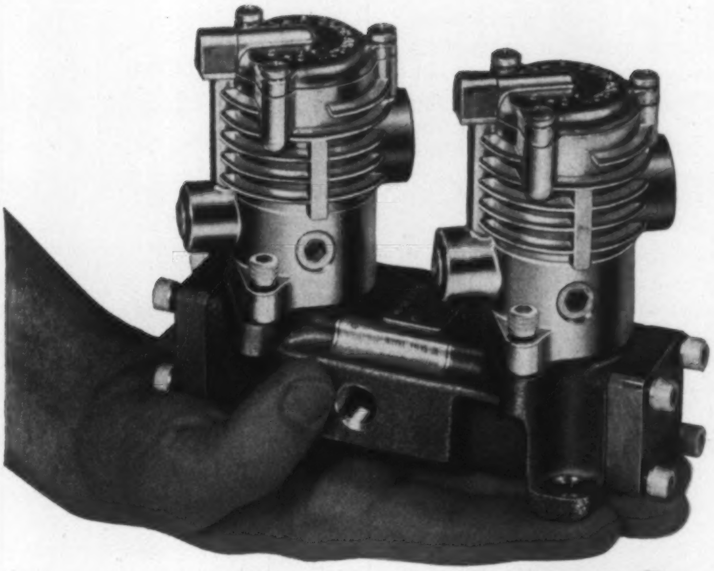
Circle 440 on Page 17

Digital Clock

Item 441

Instrument can be used to read out directly to a printer, or any other output device. Constructed with precision gears, timing motor, and coding discs, the clock covers a full 24 hours, has digital outputs in mechanical contacts down to minutes. Clock is also available with in-line visual readout of $\frac{5}{8}$-inch numerals. **Wang Laboratories Inc.,** 37 Hurley St., Cambridge 41, Mass.

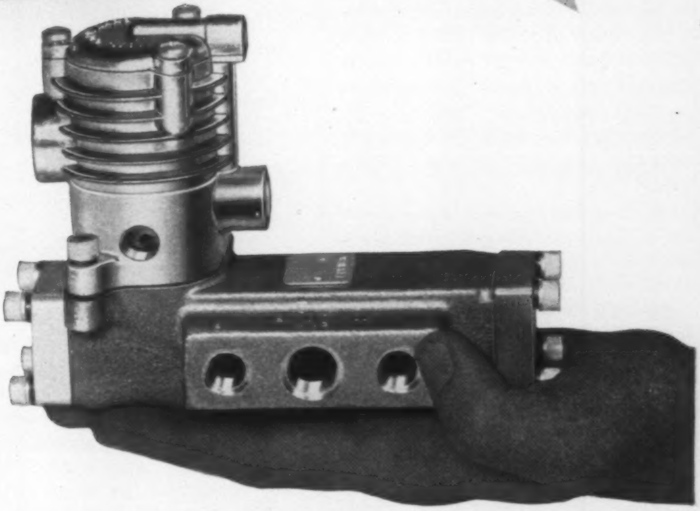
Circle 441 on Page 17



MODEL FD-120

55^{00}

LIST PRICE
BASIC VALVE



MODEL F-120

37^{00}

LIST PRICE
BASIC VALVE

op+ lic = IPd+HPr

Outstanding performance plus low initial cost equals Increased Production plus Higher Profits! Apply this formula to your operations . . . use Valvair ¼ in. 4-way foot-mounted Speed King control valves. Whether you build or operate production machinery, you'll find that Speed King's compact size simplifies installation . . . instant-action response, 600 cpm speed and bubble-tight sealing assure accurate control . . . more productivity.

What's more, 20 million cycle-plus dependability and solenoid coils guaranteed against burn-out for the life of the valve keep maintenance and down-time at a minimum! Ask your Valvair representative to show you how ¼ in. Speed Kings can keep your costs down . . . your profits up! Valvair Corporation, 454 Morgan Avenue, Akron 11, Ohio. AA-6852

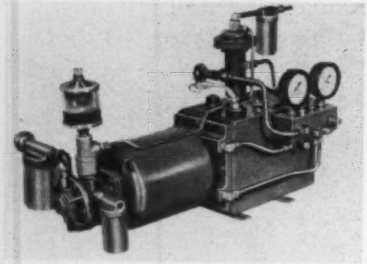
Find us fast in the 'Yellow Pages'

Compare . . . and you'll buy

Valvair

RESEARCH . . .
PROGRESS . . .
LEADERSHIP . . .

Representatives in principal cities



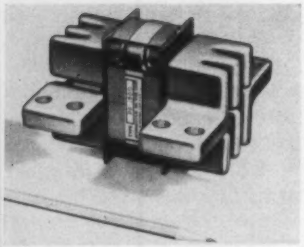
Hydraulic Power Unit

Item 442

Device features a dual control system. It can be controlled automatically; or it can be controlled by a four-way lever-operated manual valve. Dual-control is accomplished by a solenoid operated directional valve which is built into the hydraulic pump. This valve directs the hydraulic flow to either of two outlet ports in the pump. One of these ports is connected to the automatic system, the other connects with the manually operated 4-way, closed center valve.

Each of the systems is connected to a hydraulically actuated shutoff valve and combination junction block where a single set of hydraulic lines connects both systems to the hydraulic power cylinder. The hydraulic pressure in the activated system automatically opens or closes the shutoff valve as required. **Fife Mfg. Co. Inc.,** P. O. Box 878, Oklahoma City, Okla.

Circle 442 on Page 17



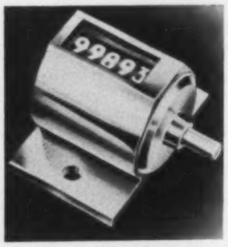
Paralleling Reactor

Item 443

Unit can be used to equalize current distribution to selenium stacks, germanium and silicon rectifiers operated in parallel, variable transformers, adjustable reactors, and rheostats. Model PR 1600 operates as a current transformer with a one to one ratio, forcing equality of current in its windings. It can be used to assure equal voltage distribution in the paralleling of bridge-type circuits, multiple groups in parallel, or multiple strings in series.

Reactor is rated at 1600 amps rms for a 50C temperature rise, with normal convection cooling. When forced air cooled, 1000 lfm rating can be increased to 2200 amps rms. **International Rectifier Corp.,** 1521 E. Grand Ave., El Segundo, Calif.

Circle 443 on Page 17



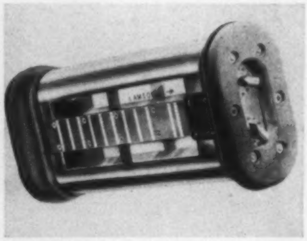
Non-Reset Counter

Item 444

Small cylindrical case unit is available in a range of 3 to 6 figures. Revolutions can be counted at a maximum of 1000 per minute, or count can be recorded at 1000 per minute with a shaft input of 100 rpm. When the driveshaft is directly connected to the initial counting wheel, actuation is cushioned by a special shock-absorbing device of nylon.

The counter provides two types of ratchet action. The action can be arranged to count in direct connection when there is oscillation or rotation in one direction. No count can be made when the driveshaft is reversed. A second type of ratchet action includes stops and a return spring for stroke counting with one count per stroke. When the actuating lever is released, the spring will return it to its original position. A minimum arc of 36 degrees is required for stroke count, and maximum counting rate is 500 per minute. The input can be assembled to add in clockwise or counterclockwise rotation with 7/8 or 1-1/16-inch drive levers available as required. **Technicraft Co.,** 6222 Ridge Ave., Philadelphia 28, Pa.

Circle 444 on Page 17



Selective Carrier

Item 445

Carrier in automatic Airtube system is large enough to handle almost any file and contains its own electrical circuit for switching to desired destination. Unit consists of a one-piece polished cast magnesium body with eight Plexiglas windows. Inside dimensions of the carrier are 2 7/16-inch by 5 5/8-inch by 14-inches. Two dials on the head allow selection of destination. **Lamson Corp.,** Syracuse 1, N. Y.

Circle 445 on Page 17

ELECTROMAX

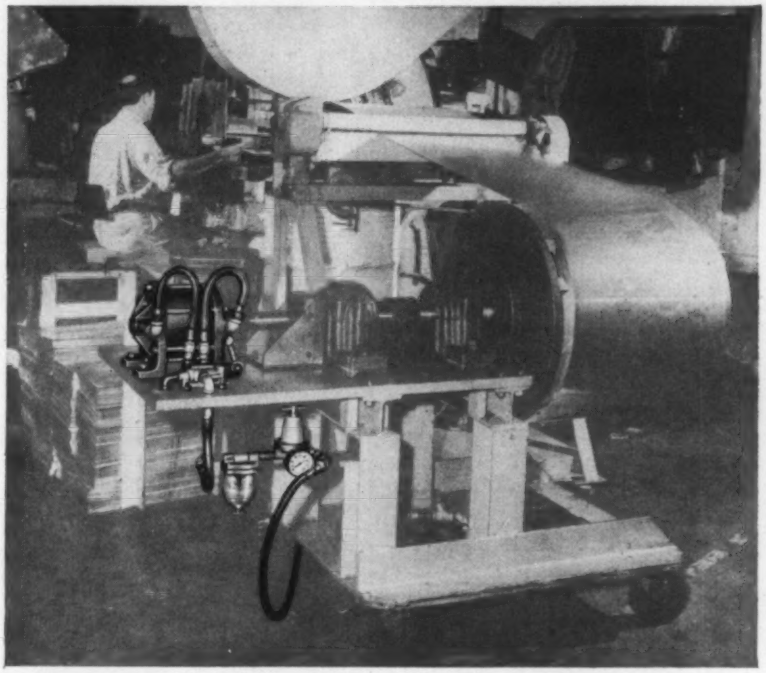
Temperature Regulator

Item 446

Unit is adaptable for use on electric and fuel-fired furnaces, ovens, some types of chemical processing units, and plastic extruding machines. It provides low cost electronic control for processes where a record or continuous indication is not required. Controller consists of a modified dc potentiometer and an electronic relay with amplifier and thermocouple fail-safe arrangement. The potentiometer measuring circuit operates directly and continuously from a standard cell. The stable detector-amplifier immediately detects unbalance to open or close the relay. Reference junction compensation is automatic.

Available for two-position control only, this thermocouple device

YOU CAN TAILOR AIR CONTROL UNITS FOR ANY JOB WITH STANDARD SCHRADER PRODUCTS



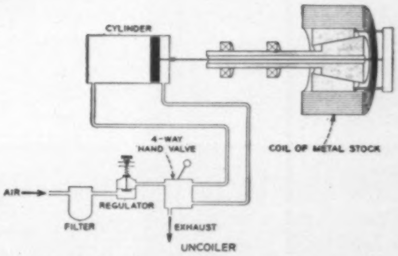
Every day more designers, more engineers are solving problems with air. They're planning air systems to hold, clamp, move, trip, feed, eject . . . from tiny parts to 3000-pound coils.

Air is versatile, economical, safe, fast. And when you select your components from Schrader, you choose from the most complete line of air products. Whenever you mechanize manual operations, or automate mechanized ones, investigate air. Schrader engineers are prepared to help you like we did here.

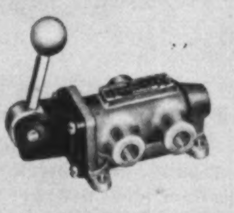
HERE'S AN INTERESTING SHOP PROBLEM SOLVED BY SCHRADER: How to strip steel from 3000-pound coils:

Radial jaws actuated by a Schrader air cylinder hold the coil firmly on an expanding mandrel. A 4-way valve and a pressure regulator govern the air power. Wherever uncoiler is needed it is plugged into an air line with quick-acting couplers. Opening the 4-way valve actuates the cylinder and the operator works freely at this machine. Just imagine the time and trouble, this one idea saves this company!

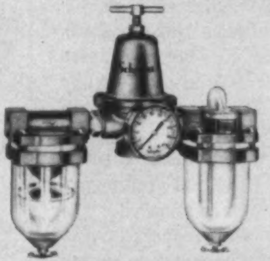
Here's the hook-up



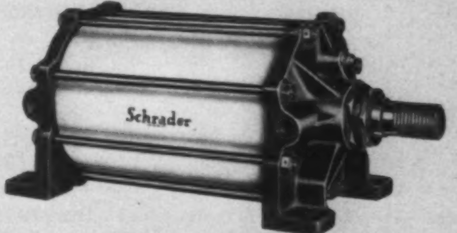
HERE ARE SOME OF THE SCHRADER PRODUCTS SELECTED FROM THE HUNDREDS OF SIZES AND TYPES:



Four-Way Hand Valve operates through a simple hand lever. Can also be operated automatically or with pedal.



Lub-air-ator: special 3-part unit that lubricates, regulates, filters air line. Easily adjusts pressure.



Double Acting Cylinder: is used here for its powerful two-direction stroke. For one way powered stroke, use single acting cylinder with integral spring return stroke.

Schrader®
a division of **SCOVILL**

We can help you put Schrader Products to work just as profitably and our Distributors are conveniently located for fast delivery.

Information is available by writing directly to us—

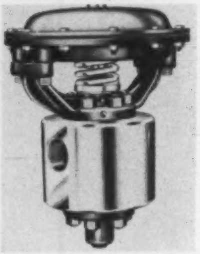
A. SCHRADER'S SON, *division of Scovill Mfg. Co., Inc.*
472 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

Circle 701 on Page 17

can regulate motor or solenoid operated valves, or an air valve with solenoid pilot, or a contactor. In operation, the control point is set at the desired point, and the switch turned *On*. The controller then activates the final control device to maintain the temperature selected. Amber and red signal lights continuously display temperature conditions. Unit is rated for 120v, 60 or 50 cycles, 25 va. **Leeds & Northrup Co.,** 4934 Stenton Ave., Philadelphia 44, Pa.

Circle 446 on Page 17

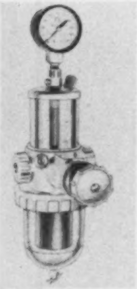


Control Valve

Item 447

Suitable for use on plastic molding, ceramic forming, and similar equipment requiring operating pressures up to 6000 psi, valve provides fast response and leak-free operation. Constructed of aluminum bronze bar stock, unit has negligible valve body distortion under high working pressures. A replaceable seat sleeve insert in the valve body assures perfect alignment of valve stem and seats. Valve diaphragm is actuated by 35 to 40 psi air. **Sinclair-Collins Valve Co.,** 454 Morgan Ave., Akron 11, Ohio

Circle 447 on Page 17

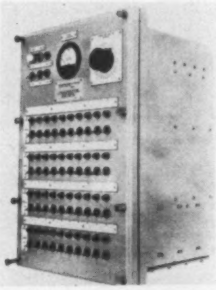


Air Line Control

Item 448

Packaged unit consists of an air regulator, filter, and lubricator, is suitable for compressed air operations, accurately regulates to desired pressure, filters water and dirt from the air line, and lubricates the air stream with a fog-like oil mist. Regulator operates on a balanced piston principle. Large seats and seals maintain accurate adjustment. Automatic bleed-off permits sensitive pressure reduction without bleeding downstream line. A cyclonic action within the filter bowl removes dirt and water. A second filtering takes place as the air passes through the filter cartridge. An external oil adjustment meters lubricant, which automatically enters the air stream as an oil mist. A filler button valve permits refilling the oil reservoir without stopping operation or shutting off the air supply. Unit is available in four pipe sizes. **Perfecting Service Co.,** 332 Atando Ave., Charlotte 6, N. C.

Circle 448 on Page 17

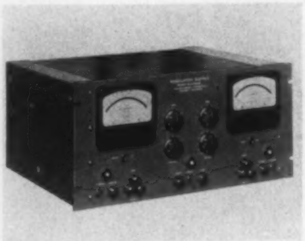


Temperature Monitor

Item 449

Scanning and indicating device automatically checks the temperatures of up to 40 thermocouples in the range of 100 to 400F every 10 seconds. It is applicable in marine and land-based power plants, textile mills, chemical processing plants, and oil refineries. The scanning circuit scans the thermocouple temperatures and triggers an alarm system which is visual and aural. The alarm indicates the locations of the thermocouples which have temperatures in excess of a preset value. The temperature can be read from the meter on the front panel. The indicator circuit monitors any one of the 40 thermocouples with a manual selector switch. A *Test* pushbutton can be used to check the continuity of the thermocouples and a fail-safe relay circuit assures proper functioning of the alarm system. **Pickard & Burns Inc.,** 240 Highland Ave., Needham Hts., Mass.

Circle 449 on Page 17



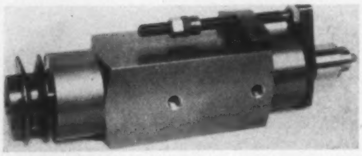
DC Power Supply

Item 450

Adaptable for use in transistor circuits, dc power supply has two outputs, each zero to 60v dc, continuously variable at 300 ma maximum. Both outputs are electrically separated and float thus can be used as positive or negative supply, or can be connected in series.

For line voltage changes of 105 to 125v ac, regulation is 20 mv change in output voltage for Model D.6-300B at 60v/300 ma output. Ripple and internal noise are below 1.5 mv rms. **Dressen-Barnes Corp.,** 250 N. Vinedo Ave., Pasadena, Calif.

Circle 450 on Page 17



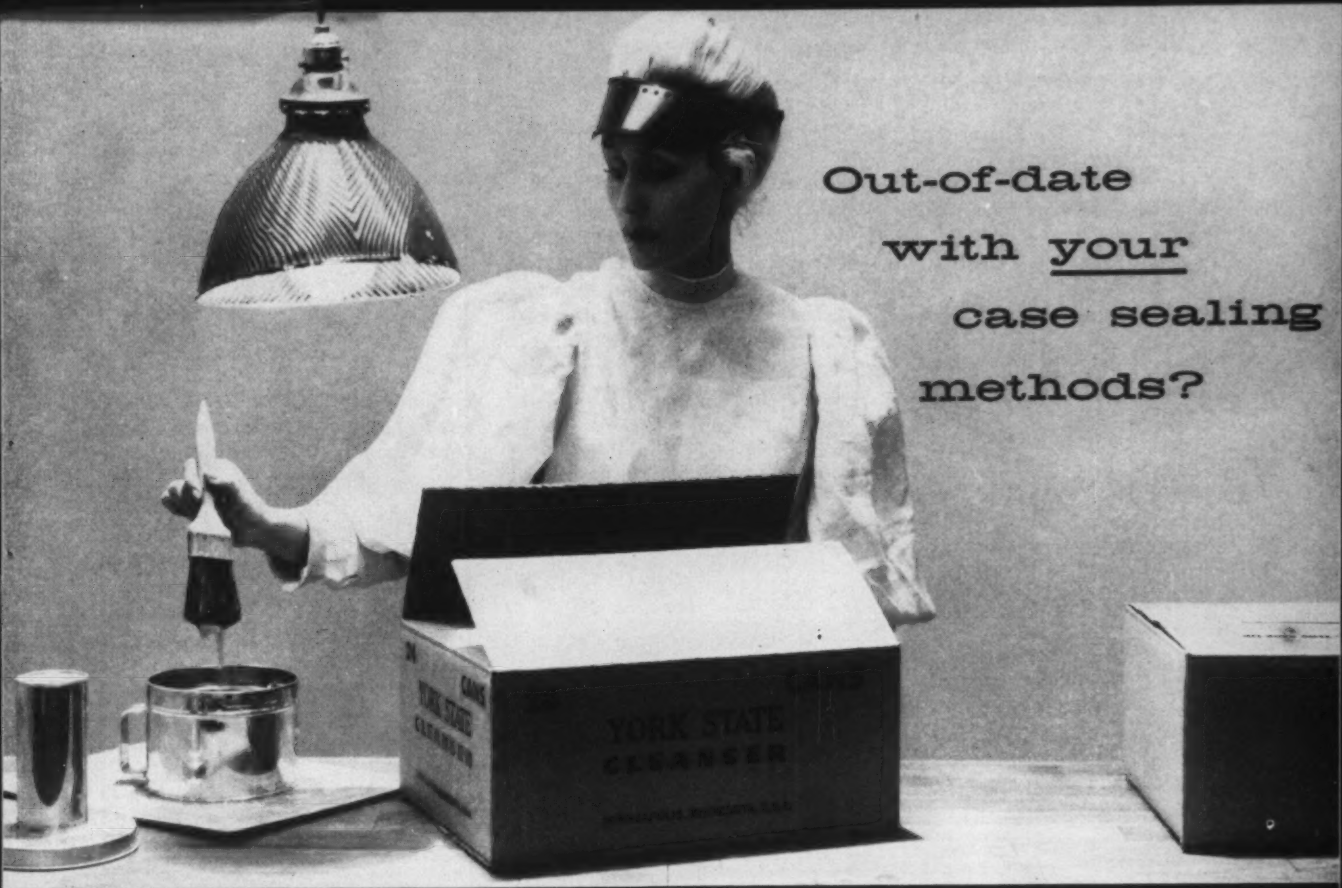
Spindle Unit

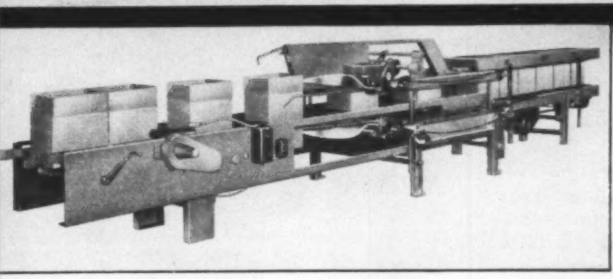
Item 451

Unit can drill, countersink, and deburr small or large quantity production runs. High speed bearings are used in the unit, and a free-sliding, double-acting cylinder is used for reciprocating motion. A micrometer stop is incorporated to give positive depth control. Unit has a $\frac{1}{4}$-inch drill capacity and a $1\frac{1}{2}$-inch stroke. **Model Machine Co. Inc.,** 4729 Hawthorne St., Philadelphia 24, Pa.

Circle 451 on Page 17

Circle 702 on Page 17→





Packomatic

T.M. Reg. U. S. Pat. Off.

equipment feeds, forms, positions, loads, seals, and imprints shipping containers automatically

PACKOMATIC FULLY-AUTOMATIC CASE SEALER

Loaded shipping containers IN, sealed cases OUT—and no operator needed! It aligns corrugated cases, positions flaps, glues, seals and discharges fully-automatically. Packomatic was first with this production-proved machine. It's available in a wide range of case sizes for installation on your present line. Semi-automatic, too.

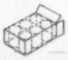
J. L. FERGUSON CO. Joliet 2, Ill.

New York, Chicago, Cleveland, Boston, Tampa, Baltimore, Portland, Denver, Los Angeles, San Francisco, Seattle, New Orleans, Louisville, Kansas City and All Principal Canadian Cities.

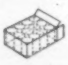
PACKOMATIC machines include the Bale Sealer — Case Sealers — Opener-Loaders — Case Imprinters — Telescoping Volumetric Filler — Packer-Gluers. Units available, semi-automatic or fully-automatic depending on your needs.

Fully-automatic Packomatic Custom-Engineered machines go all the way—or any part of the way—with your packaging operations. Modernize your present line with a fully-automatic case sealer—or really put it into high gear with a Packomatic that feeds, forms, and positions shipping containers, end-loads them with cans or cartons at top speed, then discharges them sealed and imprinted, ready for shipment. Most important, only one part-time operator is needed for the whole operation. Labor costs are obviously reduced. End-loading techniques shrink paper board costs up to 28% and your whole output takes a sharp climb. Packomatics can save time and money. Let us show you.

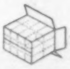
PREMIER SHOWING: Packomatic's newest high-speed bulk-packaging machine. PM&ME Booth 709



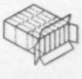
Six 5-qt. cans or gallon cans in 20⅛″ x 13⅝″ x 9 13/16″ case and 20¼″ x 13¾″ x 8¼″



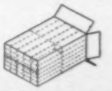
Twelve 46 oz. cans in 21″ x 13″ x 7⅛″ case



Twenty-four cartons in 12½″ x 10⅝″ x 8½″ case

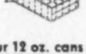


Eighteen 7 & 8 oz. cartons in 20″ x 14⅞″ x 8⅝″ case

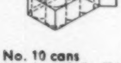


Sixty cigarette cartons
King Size: 17⅞″ x 11½″ x 22″
Regular: 14 13/16″ x 11½″ x 22″

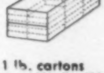
TYPICAL CASE LOADING PATTERNS FOR CANS AND CARTONS



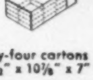
Twenty-four 12 oz. cans in 16⅜″ x 10 15/16″ x 5 3/16″ case



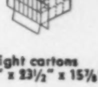
Six No. 10 cans in 22 1/16″ x 17⅜″ x 7⅛″ case



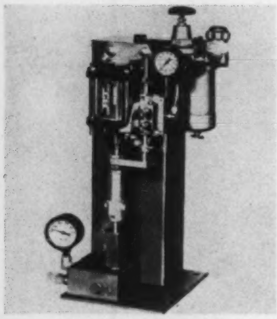
Thirty 1 lb. cartons in 16⅛″ x 10 5/16″ x 7¼″ case



Twenty-four cartons in 19½″ x 10⅞″ x 7″ case



Forty-eight cartons in 22¾″ x 23½″ x 15⅞″ case

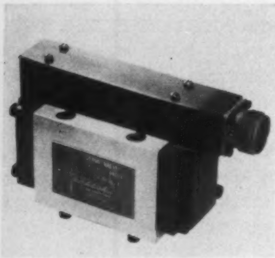


Air-Hydraulic Converter

Item 452

Applicable in the wood, plastic, and rubber industries, automatic air-hydraulic converter incorporates a micro-valve air motor, hydraulic pump, and reservoir in a single unit. The variable stroke pump is adaptable to any hydraulic requirement. It automatically and silently takes up any loss in hydraulic line pressure. A single air connection controls hydraulic output. The unit can operate at air pressures between 5 psi and 100 psi, providing a hydraulic range from zero to 10,000 psi, with full and accurate control at all pressure requirements. Single acting and compound cylinder pumps provide high pressure or dual pressure hydraulic output. Double acting models, and larger units rated to 30,000 psi hydraulic output, are available. **Renco-Toledo Inc.**, 3358 W. Alexis Rd., Toledo 13, Ohio

Circle 452 on Page 17



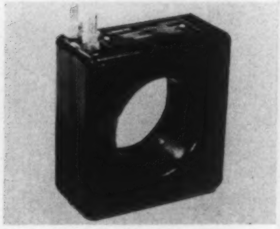
Flow Control

Item 453

Unit is designed to control the oil flow rate to a hydraulic actuator or motor in proportion to a differential current input signal from a servo amplifier. Model 140-C includes an electromechanical actuator, a zero lapped four way valve, and a double flapper boost system which drives the spool at elevated force and stiffness levels.

The spool is driven by sealed pivot rods located on each end of the servo valve. The ends of the rods work against variable nozzles mounted on the ends of the spool. The boost supply pressure enters the boost system through the center of the spool and is filtered before it reaches the fixed upstream nozzles. Flow rating of the unit at 1000 psi, is 10 gpm, operating pressure 200 to 3000 psi, and operating temperature zero to 185F. **Pegasus Laboratories Inc.**, 3690 Eleven Mile Rd., Berkley, Mich.

Circle 453 on Page 17



Meter Transformer

Item 454

Device is suitable for use with ammeters and wattmeters on industrial applications. Model CGM is available in ratings from 100 through 800 primary, 5 amp secondary; 25/400 cycles. Impulse level is 10 kv. Insulation class is 600v. The cable carrying the load current is passed through the opening in the transformer and constitutes the primary winding. Leads are carried from the terminals of the secondary winding to the meter to be operated. A multiple number of ratios can be obtained by addition of turns in the window and addition or subtraction of turns in the secondary. **Standard Transformer Co.**, Warren, Ohio.

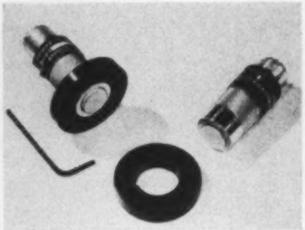
Circle 454 on Page 17

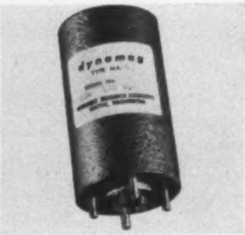
Ultrasonic Transducer

Item 455

Materials such as lead, laminated plastics, castings, and severely corroded sections can be checked for thickness and flaws with sensitive testing transducer. Model Z can also detect flaws which are very close to the surface of the material under test. A face ring around the transducer helps insure flush contact between the ultrasonic probe and the work. The ring can be removed for testing in recesses and close to perpendicular surfaces. The transducers are waterproof and designed for continuous operation at up to 250 F. They will withstand temperatures up to 450F. Unit has an overall OD of 1 inch, and a length of $1\frac{3}{8}$ inch. It is available for frequencies of 0.5 through 10 megacycles. **Branson Instruments Inc.**, 40 Brown House Rd., Stamford, Conn.

Circle 455 on Page 17



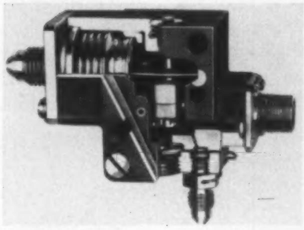


Magnetic Amplifier

Item 456

Unit is constructed to amplify signals from thermocouples, strain gages, photoelectric cells, demodulators, and instrument pick-offs to drive meter movements, electrohydraulic valves, and power amplifiers. Feedback parameters of the unit determine over-all gain and can be arranged so the load current or load voltage is independent of changes in the load value. Stability is maintained by a current or voltage negative feedback external to the amplifier. Zero drift is less than 0.2 per cent of full scale output for a temperature range of zero to 170F. Fluctuations in supply power voltage and frequency of 10 per cent give a zero error of less than 1 per cent of full scale output. Model MA 41 (shown) has a rating of 62 milliwatts, output of 10v dc maximum across a 10,000 ohm load, 18 milliamperes dc through a 200 ohm load, and a time constant (in seconds) approximately equal to the voltage gain divided by 1500. It requires a supply power of 1.5 watts, 115v rms, 400 cps. **Dynamics Research Associates, Div. of Universal Match Corp.**, P. O. Box 5841, St. Louis 21, Mo.

Circle 456 on Page 17

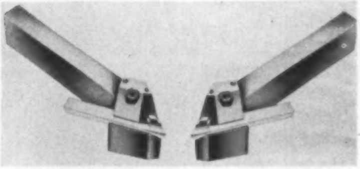


Pressure Switch

Item 457

Monitoring fluid pressures, in any application where extraordinarily severe conditions of temperature, vibration, and explosive pressure surge are met, is the function of control switch. Three-ply pressure-sensing bellows and a buckling column spring are used in the switch. The spring reduces the movement required to actuate the system. Nominal actuation settings are available from 20 to 1000 psi. Unit is explosion-proof, vibration-insensitive from 0 to 2000 cps at 40g, temperature range is from −65 F to +300 F, burst pressure 8000 psi. **Liquid Engine Div., Aerojet-General Corp.**, Azusa, Calif.

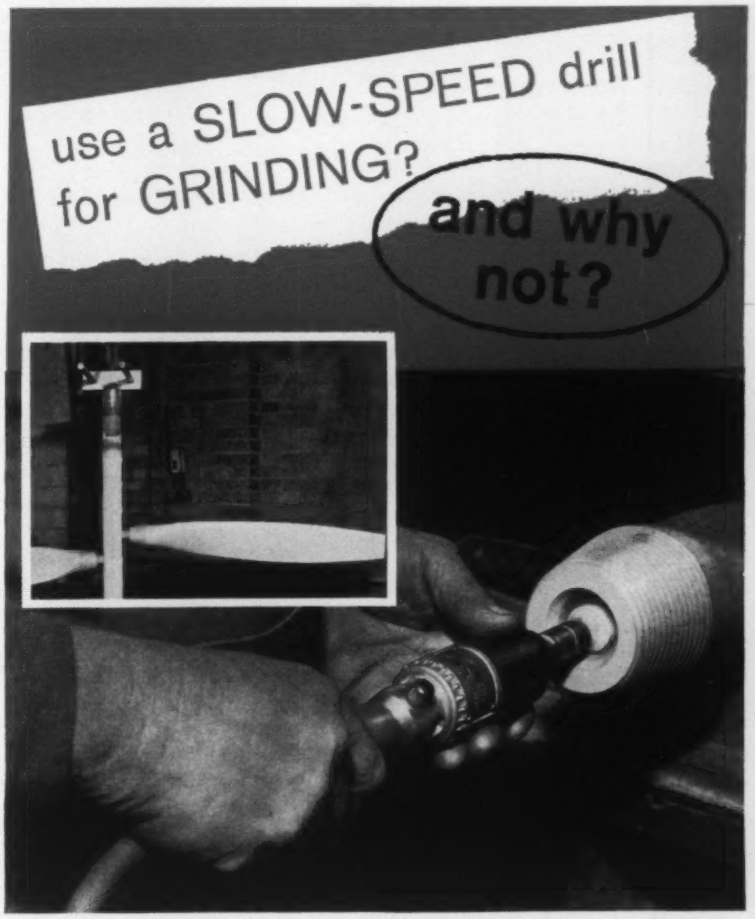
Circle 457 on Page 17



Tool Holders

Item 458

Suitable for tool rooms and production use, engine lathe carbide tool holder provides positive rake, center, and chip control. Chip control is accomplished with a carbide chipbreaker adjustable to accommodate any combination of feeds and depths of cut. Holder uses a solid carbide triangular tool bit, positioned in the holder for positive



One of the final steps in the production of propellers at McCauley Industrial Corporation is the anodizing of the propeller blades. To insure complete coverage in the vat, each blade is attached to the dipping fixture by an expanding bolt fitted into the opening at the hub end of the blade.

After anodizing, this opening must be carefully finished to remove any burrs caused by the expanding bolt. The shape of the opening requires the use of a cone wheel. The work to be done requires a slow speed tool, much slower than would normally be used with an abrasive attachment of this type and size.

So, for this metal removal job, a Buckeye drill, with cone wheel attachment, was recommended! It's a small tool, just 7 inches long; it's a light tool, less than two pounds. Makes it easy to get a perfect finishing job every time, without disturbing the exact tolerances typical of McCauley props.

The Buckeye Tools approach to unusual portable tool problems is refreshingly free from time-worn traditions and preconceived notions. Perhaps this uninhibited approach could help solve your portable tool problem.

The newest developments in air tools will be seen in

BOOTH 705
ASTE • TOOL SHOW
May 1-8 • PHILADELPHIA

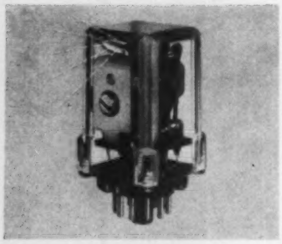
For a special air tool for a difficult job, or a standard air tool for routine work, your best buy is Buckeye. Write for our new catalog.

Buckeye Tools
CORPORATION
5009 SPRINGBORO PIKE • DAYTON, OHIO

Circle 703 on Page 17

rake turning; permitting greater depths of cut with decreased tool pressures and up to 30 per cent horsepower reduction over negative rake tools. End of shank is relieved to clear lathe center. Unit is available in two different styles (shown). **Everede Tool Co.,** 2000 N. Parkside Ave., Chicago 39, Ill.

Circle 458 on Page 17

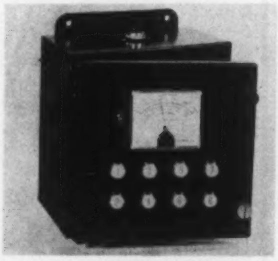


Spotlight Relay

Item 459

Built-in indicator neon lamp, which indicates circuit malfunctions instantly, is feature of relay. Unit is rated for 5 or 10 amps, up to 3 PDT dependent upon placement of neon lamp. It is available in clear and five tinted translucent shades, for color coding. **Line Electric Co.,** 271 S. 6th St., Newark 3, N. J.

Circle 459 on Page 17



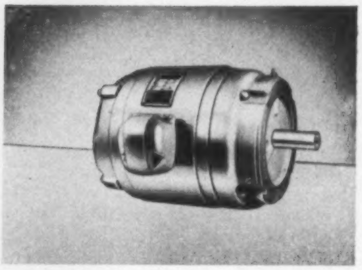
Temperature Scanner

Item 460

Instrument provides both over-temperature or under-temperature protection for systems. It is capable of scanning several control points and providing alarm if one of these temperatures exceeds or fails to reach a preset limit. Thermocouples are connected to a stepping switch, which samples the output of each thermocouple. The signal is then delivered to the signal terminals of a contact meter.

If any of the points scanned are above or below the preset limit established on the contact meter, an alarm is sounded, a light corresponding to the offending thermocouple remains lit, and the scanner is stopped at that particular point. The alarm mechanism can be located close to the points to be monitored, or can be placed at a more remote central location. Scanning rate can be as rapid as $1/2$ second per point. **Tipptronic Inc.,** Dept. MP, Chagrin Falls, Ohio.

Circle 460 on Page 17

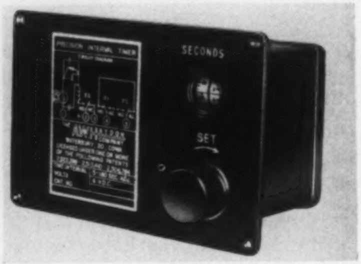


Footless Motor

Item 461

Motor designed for direct connection to driven equipment is available in ratings from 1 to 30 hp. Unit features a deflector which directs cooling air and deflects water. The one-piece frame is heat treated to prevent warpage and is completely dripproof; windings are asbestos protected. Split-type conduit box provides easy access to motor leads and can be located above, below, or on either side of the motor. **U. S. Electrical Motors Inc.,** 200 E. Slauson Ave., Los Angeles 54, Calif.

Circle 461 on Page 17



Interval Timer

Item 462

Instrument features a switching system which allows high accuracy over long range timing intervals. One switch is used to control the

You **KNOW** where the holes will be . . . with

UNIVERSAL ADJUSTABLE

U.S. Drill Heads

"Shot gun accuracy" is for the birds. With U. S. Heads you pin-point your multiple-hole drilling *exactly*—position the drilling spindles for different patterns almost as easily and quickly as you read them from your prints.

Style U-1L Universal Adjustable Head provides 9" diameter drilling area. U. S. Heads cover a wide range—6" to 15" diameter drilling areas, drill sizes up to 1-1/16". Totally-sealed, lifetime-lubricated universal joints can be interchanged quickly without tools.

Immediate delivery on most sizes. Write today for complete specification data in new catalog No. AD-57.

We manufacture all types of adjustable, fixed center and individual lead screw tapping heads.

US DRILL HEAD

UNITED STATES DRILL HEAD CO.

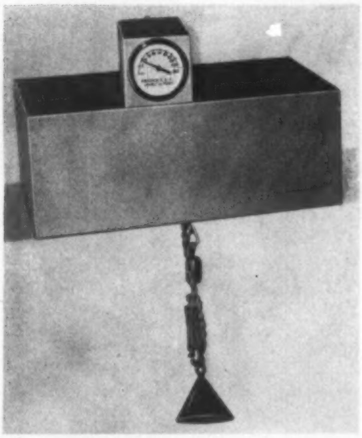
BURNS STREET • CINCINNATI 4, OHIO

Circle 704 on Page 17

timer motor, and two switches wired in series provide the time interval by closing the normally open load circuit when timing begins. This circuit can be reopened after a short period, or can be maintained in the closed position, depending on application requirements. If a normally closed circuit is required, an external relay can be used and controlled by the timer circuit.

Range of adjustment is also determined by the application requirements, and over-all ranges in excess of 30 to 1 can be supplied. Accuracy is 1 per cent or better. Model shown operates on 6v dc nominal; other models are available for 12 or 25v dc nominal, or for 50, 60, or 400 cycle operation with synchronous ac motors. **A. W. Haydon Co.,** Waterbury, Conn.

Circle 462 on Page 17



Level Measurer

Item 463

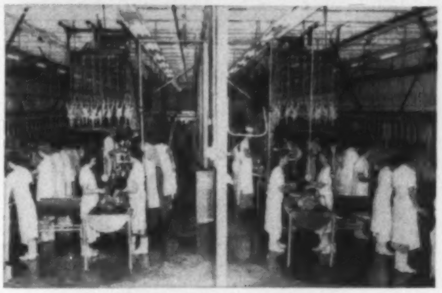
Device is applicable on powdered or granular materials in storage bins, tanks, or piles. Model WL57 consists of two units—a cable operating and transmitting unit located at the top of the tank or bin, and a receiving and indicating unit designed for panel mounting with other instrumentation. A retransmitting slidewire is included for the control of an appropriate processing mechanism.

When a weighted bob contacts the surface of the material being measured, the tension in the cable supporting the bob is changed. The bob is repeatedly raised and lowered and the cable length at which contact occurs is continuously measured

BUSCHMAN E W B CONVEYORS

Every Way Better for Every Industry

Overhead cable and roller conveyors are used in this wholesale drug warehouse to speed up order picking.



6000 chickens per hour move from coop to consumer, by overhead cable conveyor at this new poultry processing plant.

Buschman *Bush-Lock Design*

OVERHEAD CABLE CONVEYORS

Low initial cost . . . trouble-free operation . . . outstanding versatility . . . every advantage is yours with Buschman Cable Conveyors, industry's first choice for everyday transportation of light and medium loads.

Whatever your materials handling problem, Buschman "on the job" engineering know-how assures an installation that is every way better. Make low-cost production a reality, consult Buschman.

Cable conveyors carry light to medium weight loads through all operations at convenient heights in this modern manufacturing plant.

Complete Conveyor Systems for all types of industries . . . Engineered, Manufactured, Installed.

Every Way Better **E W B**

Buschman
BUSH-LOCK

C-345-EWB

Write today for literature.

THE E. W. BUSCHMAN CO.
4551 Clifton Avenue, Cincinnati 32, Ohio

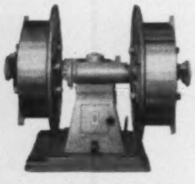
Circle 705 on Page 17

LITTELL REELS

AUTOMATE...

HANDLING OF COILS FROM 100 LBS. TO 20 TONS

No. 5 AUTOMATIC CENTERING REEL
Ball bearing smoothness. Adjustable brake. Adjustable in height. Tilts to any angle for unreeling. Takes coils up to 600 lbs., 10" wide. 46" max. O.D., 8½" to 20" I.D.



No. 25-18 DOUBLE REEL
Automatic centering. Reserve coil is swiveled and locked in Pay-out position in seconds. Adjustable electric brake. 2500-lb. coil on each side.

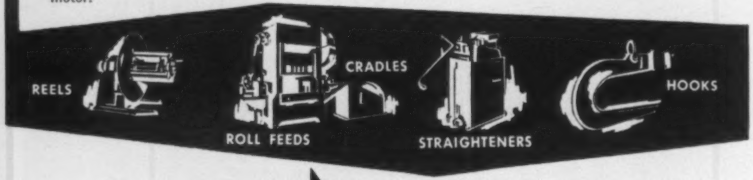
No. 60-30 MOTOR DRIVEN REEL
with automatic centering. Takes up to 6,000 lb. coils, 30" wide. 48" max. O.D. 16" to 20" I.D. 3 HP, 1200 rpm motor.

A Littell Reel *best* meets your need for fast, safe coil handling and accurate pay-off. The Littell Line offers all types of reels as well as all sizes . . . Manual Reels, Motor Driven Reels, Double Reels and the newest design Brake Reels. All are designed and built with the engineering and experience that has made Littell Reels the standard of performance since coil stock first came out.

FAST DELIVERIES

from complete stocks in the newly enlarged Littell plant.

SEE OUR CATALOG IN SWEET'S



Use this coupon
for the Littell Reel Catalog.

F. J. LITTELL MACHINE CO.

4105 N. Ravenswood Ave.
Chicago 13, Illinois
District Offices: Detroit, Cleveland

F. J. Littell Machine Co.
4105 Ravenswood, Chicago 13, Ill.
Send Littell Reel Catalogs "D"

NAME ______

COMPANY ______

STREET ______

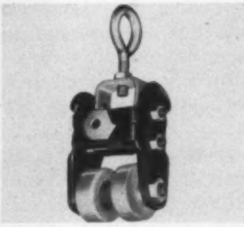
CITY ______ ZONE ______ STATE ______

R

Circle 706 on Page 17

electrically. **Ramsey Engineering Co.**, 2451 University Ave., St. Paul, Minn.

Circle 463 on Page 17

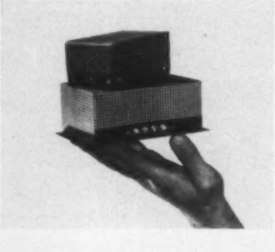


Nylon Wheeled Trolley

Item 464

Trolleys with nylon wheels installed in bronze trolley side plates are adaptable for explosion-proof applications. The nylon wheels eliminate sparking from wheel contact on the inverted T-rail. The bronze side plates will not spark if they brush against metal. The trolleys require no lubrication, are also suitable for the food and canning industry where cleanliness is essential. Since the nylon wheels reduce operating noise, they are also useful in applications where noise is objectionable. **Tipp Mfg. Co.**, Fourth & Franklin Streets, Tipp City, Ohio

Circle 464 on Page 17



Remote Control System

Item 465

Subminiature electronic control system is adaptable to gates, freight car grain unloaders, blast furnace doors, lighting, or any application requiring the control of electrical and electromechanical devices from remote locations. Device utilizes transistors, printed circuits, hermetically sealed components, quartz crystal frequency stabilization, and extremely low operating voltages. It is designed to eliminate radio interference with other services. The receiver is activated only by signals generated by its companion transmitter. Normal control range is 100 feet, but the transmitter can be adjusted to cover distances up to one quarter mile. System is available in 40 different operating channels. **D. W. Thomas Engineering Inc.**, 806 Robertson Blvd., Los Angeles 36, Calif.

Circle 465 on Page 17

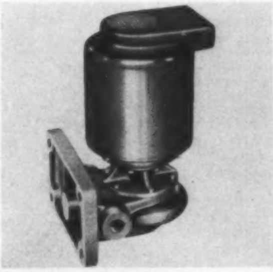
Amperex
7092

High Power Triode

Item 466

Model 7092 is designed for industrial oscillator applications in ultrasonic, induction, or dielectric heating equipment. Tube does not require water cooling and is able to withstand heavy overloads. The tube envelope is constructed of extra-thick, hard glass for temperature resistance and ruggedness. When used in continuous class C operation, 2 kw power into industrial loads can be obtained, and 3 kw in intermittent operation. The thoriated-tungsten filament of the unit is rated at 6.3v, 32.5 amp. **Industrial Tube Div., Amperex Electronic Corp.**, 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 466 on Page 17

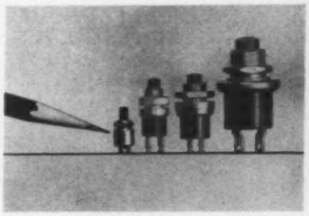


Triple Discharge Pump

Item 467

Designed for use where limited space is a factor, or where a shallow reservoir is involved, pump features three discharges, one on the right side of the housing, one on the left, and one through the inlet part of the mounting flange. The discharges can be used individually, in pairs, or simultaneously. Model 5S-4520 is available with 1/10 hp, 3450 rpm or 1725 rpm motor and in 1/4 hp at 3450 rpm. Various diameter impellers are offered for capacities up to 30 gpm and heads up to 27 feet. **Ruthman Machinery Co.**, 1809 Reading, Cincinnati 2, Ohio

Circle 467 on Page 17



Miniature Pushbutton

Item 468

Miniature switch is a single-pole, single throw, momentary contact,

GEM-17 DIAL INDEX TABLE
TRUE GENEVA MOTION

FOR FAST, *ACCURATE* AUTOMATION OF ASSEMBLY *and* MACHINING OPERATIONS

This new, high precision index table is accurate to plus or minus 0.001 in. on a 13 in. dia. work circle; can position work in as little as ½ sec.; indexes a 1,000 lb. fixture load.

BASIC SPECIFICATIONS: Standard Number of Stations—6, 8 or 12; 3 and 4 skip. Motor—Rotary air, fluid, or electric. Dial Plate—17 in. dia. standard; larger plates available. Rotation—Either direction. Interlock—Limit switch operated directly off locking bolt. Weight—200 lbs.

Gray engineers will help you adapt GEM-17 to your use. For recommendations, send specifications of your application. Illustrated brochure GE-21 and prices on request.

GRAY EQUIPMENT COMPANY
13600 Ford Road • Dearborn, Michigan • Telephone: TIffany 6-7573

Circle 707 on Page 17

New Heating Problem?
Old Production Headache?

℞ Time-saving
far-infrared heat

Your Chromalox Man has the ANSWERS

Chromalox Electric Far-Infrared

Simply and precisely controlled, even over largest work areas.

Absorbed uniformly and quickly by practically all colors, even optically transparent materials.

All-metal, self cleaning.

High performance without high pressures.

No smoke, fumes, flames.

Cooler, cleaner, no glare.

Immediate shipment of standard heaters. World's largest stock.

Get details. Call or write today.

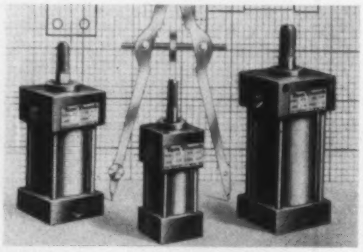
2642

Chromalox Electric Heat
Edwin L. Wiegand Company
7850 Thomas Blvd. • Pittsburgh 8, Pa.

Circle 708 on Page 17

normally open unit, rated 1/10 amp at 115v ac resistive. Life expectancy is 200,000 operations minimum at the rated load. Switch is designed for use with 1/16-inch panels, requires a 3/16-inch hole for mounting. Red pushbutton has approximately 1/32-inch movement. **Grayhill Inc.**, 561 Hillgrove Ave., La Grange, Ill.

Circle 468 on Page 17

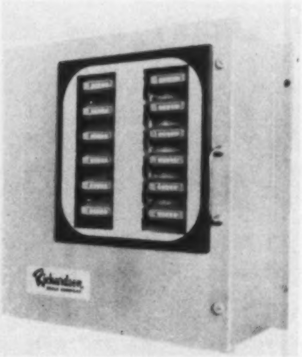


Miniature Cylinders

Item 469

Line of heavy duty, miniature cylinders is available in eight mounting styles, three bore sizes, any length of stroke required, and in either double-acting, or single-acting spring return types. Pressure ratings are 200 psi for air, 2000 psi for hydraulic. The ¾-inch bore has a ¼-inch rod; 1-inch bore, 5/16-inch rod; and the 1⅛-inch bore, ⅜-inch rod. **Pneumatic-Hydraulic Development Co. Inc.**, P. O. Box 943, Fort Wayne, Ind.

Circle 469 on Page 17



Blending Recorder

Item 470

Device maintains an accurate inventory check on each ingredient being fed into a proportioning system. The unit records the weight of each ingredient used during any

Call Chromalox

for the man with the
ELECTRICAL ANSWERS
to your heating problems

ATLANTA 3, GA.
Applebee-Church, Inc.
1389 Peachtree St., N.E.
TRinity 5-7244

BALA-CYNWYD, PA.
J. V. Calhoun Co.
349 Montgomery Ave.
MOhawk 4-6113

BALTIMORE 18, MD.
Paul B. Renoff Co.
333 E. 25th St.
HOpkins 7-3280

BINGHAMTON, N. Y.
R. P. Smith Co., Inc.
2507 James Street
Phone 4-7703

BLOOMFIELD, N. J.
R. L. Faber & Associates, Inc.
1246 Broad Street
EDison 8-6900

BOSTON 11, MASS.
Leo C. Pelkus and Co., Inc.
683 Atlantic Ave.
LIberty 2-1941

BUFFALO 2, N. Y.
Niagara Electric Sales Co.
505 Delaware Avenue
SUmmer 4000

CHARLOTTE 2, N. C.
Ranson, Wallace & Co.
116½ East Fourth St.
EDison 4-4244
FRanklin 5-1044

CHATTANOOGA 1, TENN.
H. R. Miles and Associates
P. O. Box 172
Phone 5-3862

CHICAGO 5, ILL.
Fred I. Tourtelot Co.
407 S. Dearborn Street
HArrison 7-5507

CINCINNATI 8, OHIO
The Smysor Company
1046 Delta Avenue
TRinity 1-0605

CLEARWATER, FLA.
J. J. Galleher
617 Cleveland Street
P. O. Box 1376
Phone 3-7706

CLEVELAND 13, OHIO
Anderson-Bolds, Inc.
2012 W. 25th Street
PRospect 1-7112

DALLAS 26, TEXAS
L. R. Ward Company
3009-11 Canton Street
RIverside 1-6279

DAVENPORT, IOWA
Volco Company
215 Kahl Bldg.
Phone: 3-2144

DENVER 2, COLO.
E. & M. Equipment Co.
2415 15th Street
GLendale 5-3651
GEnesee 3-0821

DES MOINES 14, IOWA
Midwest Equip. Co. of Iowa
842 Fifth Avenue
CHerry 3-1203

DETROIT 38, MICH.
Carman Adams, Inc.
15760 James Couzens Hwy.
UNiversity 3-9100

HOUSTON 3, TEXAS
L. R. Ward Company
3605 Polk Avenue
CApitol 5-0356

INDIANAPOLIS 4, IND.
Couchman-Conant, Inc.
627-631 Architects &
Builders Bldg.
MElrose 5-5313

KANSAS CITY 6, MO.
Fraser D. Moore Co.
106 E. 14th Street
VIctor 2-3306

LOS ANGELES 15, CALIF.
Montgomery Brothers
1053 South Olive Street
RIchmond 7-9401

MIDDLETOWN, CONN.
Dittman and Greer, Inc.
33 Pleasant Street
DIamond 6-9606

MILWAUKEE 3, WIS.
Gordon Hatch Co., Inc.
531 W. Wisconsin Avenue
BRoadway 1-3021

MINNEAPOLIS 4, MINN.
Volco Company
831 South Sixth Street
FEderal 6-3373

NASHVILLE 4, TENN.
H. R. Miles and Associates
2500-B Franklin Road
CYpress 2-7016

NEW YORK CITY, N. Y.
See "Bloomfield, N. J."
WOrth 4-2990

OMAHA 2, NEB.
Midwest Equipment Co.
of Omaha
1614 Izard Street
ATlantic 7600

PHILADELPHIA, PA.
See "Bala-Cynwyd, Pa."
GReenwood 3-4477

PITTSBURGH 6, PA.
Woessner-McKnight Co.
1310 Highland Bldg.
115 S. Highland Avenue
EMerson 1-2900

PORTLAND 9, ORE.
Montgomery Brothers
1632 N.W. Johnson Street
CApitol 3-4197

RICHMOND 26, VA.
(Branch, Charlotte)
ATlantic 8-8758

ROCHESTER 4, N. Y.
Niagara Electric Sales Co.
133 Clinton Avenue, South
HAmilton 6-2070

ST. LOUIS 1, MO.
C. B. Fall Company
317 N. 11th St., Suite 1001
CHestnut 1-2433

SAN FRANCISCO 3, CALIF.
Montgomery Brothers
1122 Howard Street
UNderhill 1-3527

SEATTLE 4, WASH.
Montgomery Brothers
911 Western Avenue
SEneca 3270

SYRACUSE 6, N. Y.
R. P. Smith Co., Inc.
2507 James Street
HOward 3-2748

WICHITA 2, KANS.
Fraser D. Moore Co.
Room 211 Derby Building
352 N. Broadway
AMherst 2-5647

Circle 708 on Page 17

batch or during any required interval of time, and totalizes the weight of all ingredients used, providing an up-to-date record of the material left in storage. The unit consists of twelve separate counters; eleven are used for separate ingredients, and the twelfth counter is used for totalizing.

When an ingredient is used in a batch, the inventory counter for that material will record in pounds the weight of material withdrawn from storage and used in the batch; and the totalizer counter also will record the weight in pounds. When the next ingredient is introduced, the register for that ingredient will record weight used and the same amount will be added to the totalizer counter. **Richardson Scale Co.**, Van Houten Ave., Clifton, N. J.

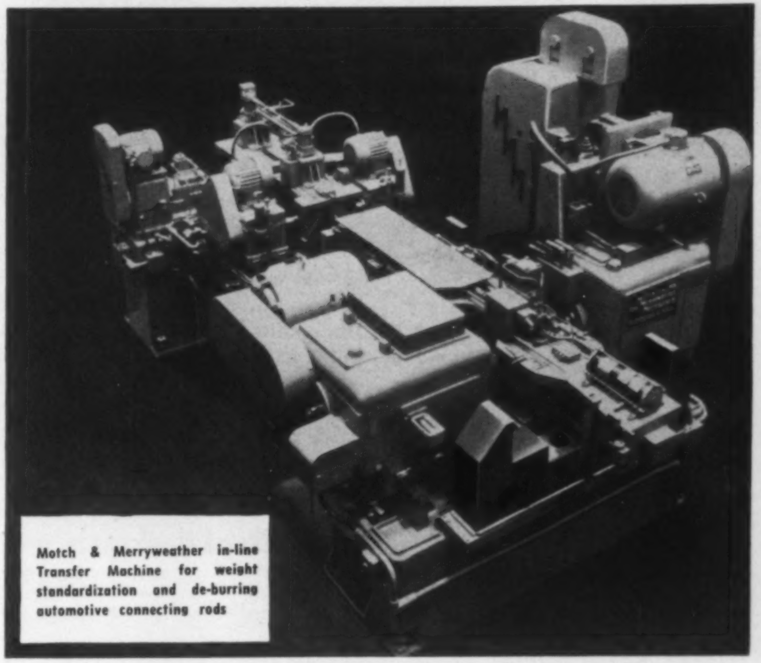
Circle 470 on Page 17

Flow Meter

Item 471

Capable of measuring low flow rates, meter is suitable in research laboratories, pilot plants, and bench-scale operations. The instrument utilizes a Tapor-Flo principle. The float lines out quickly without bobbing, to permit exact reading of flow value without visual averaging. As the flow rate increases or decreases, a superfine-finished float rises or falls in a precision-bore glass tube, proportionately exposing a V-shaped orifice. The orifice is shaped by ultrasonic impact grinding, providing the float height to be directly proportional to flow rate. The flow value is indicated on an evenly-graduated scale that is etched into the side of the flow tube.

For periodic cleaning, or for meter range change, only one threaded fitting is removed to dismantle the



Motch & Merryweather in-line Transfer Machine for weight standardization and de-burring automotive connecting rods

SHADOGRAPH® SCALES

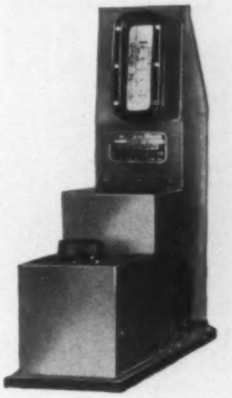
control weight standardization

for automated transfer machine

Production of automotive connecting rods increased from 150 to 320 rods per hour . . . quality and uniformity of product improved. These and other benefits are provided by the machine above equipped with Exact Weight Shadograph Scales.

In the machine's fast, automatic cycle, Shadograph Scales first weigh the rods for milling weight bosses on both ends. After milling operations, the rods are checkweighed and accepted or rejected for de-burring.

Exact Weight equipment is used in many types of automated machines including food packaging, metal working, meat slicing and plastics weigh feeders. Write for complete engineering data.



SHADOGRAPHS are available in models adapted to your particular needs. Capacities from 1 gram to 100 lbs.

THE EXACT WEIGHT SCALE CO.
907 W. FIFTH AVE., COLUMBUS 8, OHIO
In Canada: P.O. Box 179, Station S, Toronto 18, Ont.

Exact Weight SCALES

Sales and Service from Coast to Coast

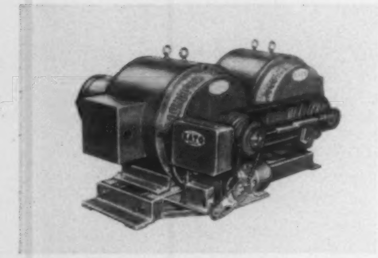
Find us in your local 'Yellow Pages'

BETTER QUALITY CONTROL . . . BETTER COST CONTROL

Circle 709 on Page 17

instrument. Flow range depends on the specific gravity of the fluid, the size of the flow tube, and the weight of the float. Standard flow tube sizes available are ¼ or ½-inch ID. Maximum operating pressure is 80 psi at 70F and maximum operating temperature is 150 F. **C-Mar Corp.**, 35 Euclid Ave., Manasquan, N. J.

Circle 471 on Page 17



Motor-Generator

Item 472

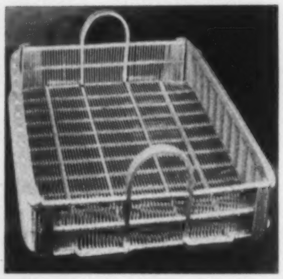
Unit features a pushbutton frequency adjustment from any location. Set includes a 1200 rpm synchronous motor and 1200 rpm revolving field generator. Generator speed is 1080 rpm for 360 cps, 1320 rpm for 440 cps. Generator rating is 5 kw, 3 phase. An adjusting motor with a reduction gear provides power to alter pitch of variable pulleys on both motor and generator. Increase and decrease of speed is controlled by pushing *Fast* or *Slow* pushbuttons.

Control equipment includes magnetic amplifier type voltage regulator, synchronous motor starter, load limit switch, and reset buttons. Voltage regulation is ±1 per cent from no load to full load. **Kato Engineering Co.**, 1415 First Ave., Mankato, Minn.

Circle 472 on Page 17

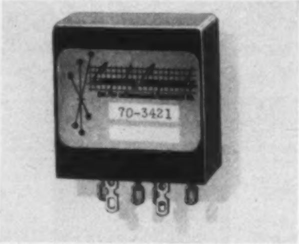
Heat Treat Baskets

Item 473



Designed for heat treating applications, basket construction of special looped wire and riveted support rods provides strength and allows for expansion and contraction. The support rod members are passed through the wires which have been formed into spaced loops. The one-piece inner frame is an integral part of the load support, yet remains free from restriction. All baskets are custom designed for specific heat treat applications. **Bix Co.**, Fairgrounds Road, Wellington, Ohio.

Circle 473 on Page 17

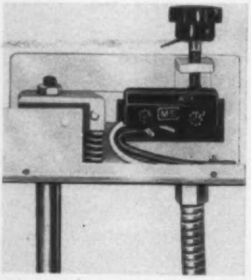


Pulse Transformer

Item 474

Device is suitable for high current magnetic recording head drive circuits in digital recording applications. Primary, secondary, and two secondaries are close coupled to permit use as a read-write circuit. Entire unit is potted in a high temperature moisture resistant epoxy. Turns ratio of 1 to 2 to 1 can be modified to match circuits for various heads. **Computer Components Div., International Resistance Co.**, 401 N. Broad St., Philadelphia 8, Pa.

Circle 474 on Page 17



Temperature Control

Item 475

Automatic and accurate control of high and low temperature in a

all overhead trolley conveying systems

ARE NOT ALIKE!

SUPERIOR ENGINEERING is the BIG "PLUS" at A-F

TAPPING THE *FULL* cost-cutting potential of an overhead trolley conveying system takes far more than "average" engineering skill.

Because of Alvey-Ferguson's unsurpassed engineering "know-how", A-F *Engineered* Conveying Systems are making new operational savings in plants of all types.

For fully automated and semi-automated applications, A-F also *engineers* control centers, positioning devices, automatic loading and discharge units, other ancillary equipment.

Whatever your product handling needs, A-F can *engineer* the *proper type* of conveying system to cut costs in *your* plant . . . *make money for you!* Write us — without obligation—today!

YOU CAN SEE
THE SUPERIORITY
OF A-F CONVEYOR ENGINEERING

A-F

A-F *ENGINEERED*
CONVEYING SYSTEMS
Also Pre-Engineered Conveyors—
Wheel, Trolley, Roller, Belt
Metal Cleaning and Processing Machines

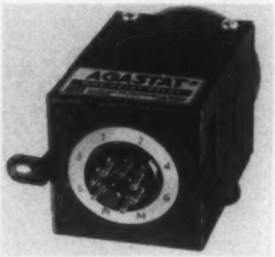
THE ALVEY-FERGUSON CO., 171 Disney St., CINCINNATI 9, OHIO and Azusa, California

Circle 711 on Page 17

wide variety of materials is accomplished by an instrument with sensitive operating differentials as close as ±1/4F over a range from below zero to 1800F. It can control temperatures of liquids, gases, or solids. An increase in temperature causes an outer tube to expand more than an inner tube, because the outer tube has a higher coefficient of linear expansion than the inner tube. This different rate of expansion causes the inside tube to move relative to the outside tube, closing a limit switch and cutting off the heat. On a temperature drop, the action is reversed.

For units operating above 300F, the inside tube is made of two sections of welded stainless steel tubing. The section connected to the instrument head is inactive and not affected by temperature change. The lower tube is sensitively activated within fine limits of change. Both electric and pneumatic controls are available with mounting equipment for all applications. **Burling Instrument Co.**, Chatham, N. J.

Circle 475 on Page 17



Time Delay Relay

Item 476

Adaptable to products and machines using plug-in components, device is available with either of two timing adjustments, a needle valve or a dial head adjustment. Each is adjustable from 0.1 second to 15 minutes. Four timing ranges are available in the dial head type. Relay is relatively unaffected by wide temperature changes from −65 to +160F. It is suitable for ac operation at all standard voltages from 6 to 550v, 60 cycles and 25 cycles. For dc operation, voltage is from 6 to 230v. **A'G'A Div., Elastic Stop Nut Corp. of America**, Elizabeth, N. J.

Circle 476 on Page 17

Solenoid Valve

Item 477

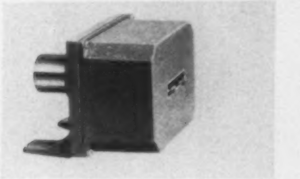
Designed for the flow control of water, air, light oils, brines, low pressure steam, industrial gas, and other fluids, solenoid valve has a maximum operating pressure differential of 150 psi. Typical flow control applications are in lubrication systems, garbage disposals, laundry equipment, automatic lawn sprinklers, circulating water heating and cooling, industrial air and water systems. The valve uses the principle of pilot port operation, has only two moving parts, and can be mounted in any position. **Controls Div., Jackes-Evans Mfg. Co.**, 4427 Geraldine Ave., St. Louis 15, Mo.

Circle 477 on Page 17

Photoelectric Control

Item 478

Device changes from *Dark* energized to *Light* energized with a flick of a switch. With the *Dark* energized setting the control relay energizes when the phototube is dark; with the *Light* energized setting the control relay energizes when light is on the phototube. Photoelectric control operates with 5 foot-candles minimum light; 0.025 second minimum dark time; 0.025 second minimum light time. Contacts are dpdt, rated 8 amp at 115v ac noninductive load. Unit is enclosed in a gasket-sealed cast aluminum case, tapped for 1/2-inch conduit. Lens diameter is 1 1/2 inches, power consumption 20w. **Autotron Inc.**, P. O. Box 722-RR, Danville, Ill.



Circle 478 on Page 17

VECO the BIG name in

THERMISTORS • VARISTORS

For reliability, stability, dependable delivery and experienced engineering know-how, consult VECO, the most progressive manufacturer of thermistors and varistors. Through constant research, development and precision control, VECO's products are guaranteed for peak performance and long life. At all times, VECO strives to improve its product for the benefit of its customers.

MANUFACTURERS OF
VECO
Thermistors and varistors
Compactrol (electronic controls) (Pat. Applied for)
Tap-A-Therm (Multi-tapped thermistors) (Pat. Applied for)
Gas Analysis and chromatography cells
Combustion Analyzers
Temperature Sensing Devices
Constant Temperature Baths and Controls

Descriptive literature covering each item available on request

NEW TECHNICAL CATALOG AVAILABLE
8th edition — containing pertinent data and condensed engineering specifications covering over 250 VECO stock items.

Send for the interesting, informative series entitled, *"MEET THE VECO THERMISTOR"*

VECO trade mark

Victory
ENGINEERING CORPORATION
88 Springfield Road, Union, N. J.
Telephone: MUrdock 8-7150

See us at the IRE Show
BOOTH 2230
New York Coliseum
March 24th thru 27th

Circle 712 on Page 17

Speed Variator

ACCURATE CONTROL and high speed of response are provided by the new General Electric Speed Variator. This complete, packaged drive, including power unit, drive motor and operator's control has been designed to meet your needs for greater flexibility. The Speed Variator unit is factory assembled, wired and tested . . . ready to be connected to your a-c line.

NEW

General Electric Speed Variator

An Adjustable-speed Drive
with . . .

- Amplistat® Regulator
- Static Exciter
- Kinamatic* Drive Motors
- Silicon Rectifiers
- Two-Unit, Four-Bearing Motor-Generator Set

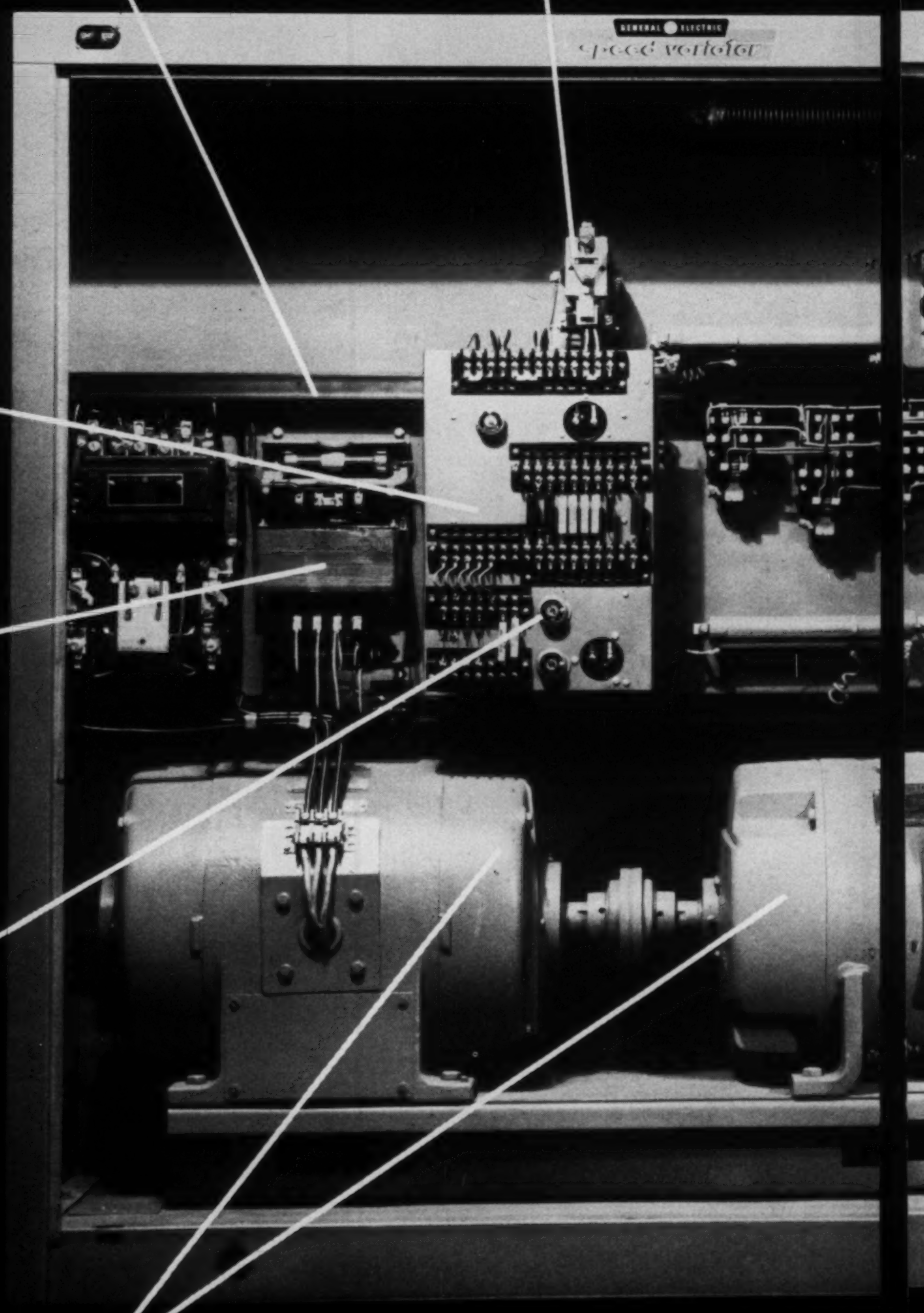
*Trademark of General Electric Company

See how the new Speed Variator cuts costs

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle 744 on Page 17



RECESSED WIRING TROUGHS simplify installation and inspection. Permit back-to-back mounting of control panels when required.

FRONT-CONNECTED CONTROL COMPONENTS make servicing and replacement easy. Standard parts can be replaced from stock.

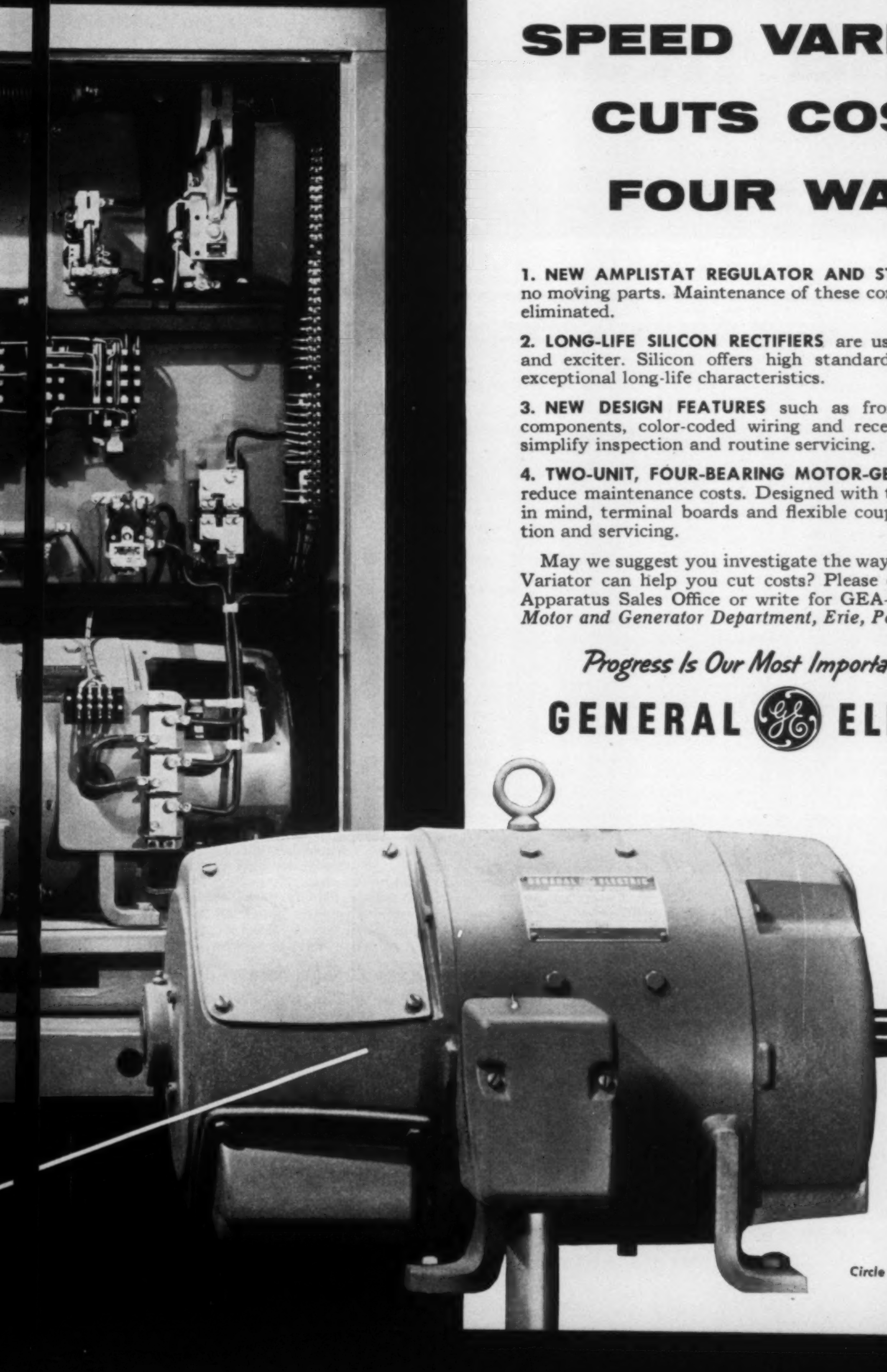
AMPLISTAT REGULATOR is standard equipment on new Speed Variator. It holds speed steady under varying loads . . . has no moving parts.

STATIC EXCITER permits immediate operation because it requires no warm-up time.

TIMED ACCELERATION AND DECELERATION permits smooth, controlled starts by means of simple potentiometer knob adjustment.

TWO-UNIT, FOUR-BEARING MOTOR-GENERATOR SET features latest design Tri-Clad† '55' alternating-current motor and direct-current generator. In ratings 3 through 50 hp, set is mounted on base in which special openings have been provided so that it can be removed by fork truck.

KINAMATIC DRIVE MOTOR can handle greater momentary loads. It provides split-second response to control signals; more power per pound and greater versatility.



NEW

SPEED VARIATOR CUTS COSTS FOUR WAYS

1. **NEW AMPLISTAT REGULATOR AND STATIC EXCITER** have no moving parts. Maintenance of these components is virtually eliminated.

2. **LONG-LIFE SILICON RECTIFIERS** are used in both regulator and exciter. Silicon offers high standards of reliability and exceptional long-life characteristics.

3. **NEW DESIGN FEATURES** such as front-connected control components, color-coded wiring and recessed wiring troughs, simplify inspection and routine servicing.

4. **TWO-UNIT, FOUR-BEARING MOTOR-GENERATOR SET** helps reduce maintenance costs. Designed with the maintenance man in mind, terminal boards and flexible coupling simplify inspection and servicing.

May we suggest you investigate the ways the new G-E Speed Variator can help you cut costs? Please contact your nearest Apparatus Sales Office or write for GEA-6643. *Direct Current Motor and Generator Department, Erie, Pennsylvania.* 813-14

Progress Is Our Most Important Product

GENERAL ELECTRIC

†Registered Trademark
General Electric Company

Circle 716 on Page 17

catalogs and literature

Latest automation information. For copies use card page 17.

Gears & Speed Reducers

Grant Gear Works Inc., 154 W. Second St., Boston 27, Mass.—180 page catalog—Line of speed reducers, custom gears, and commercial gears is covered in Catalog 80. Speed reducer section describes eight types of reducers available in worm and gear, single and double reductions. Sizes, ranges, capacities, and specifications of all units available are listed.

Circle 479 on Page 17

Digital Control

Anatran Corp., 45 W. Union St., Pasadena, Calif.—4 page pamphlet—Data in pamphlet applicable to servo systems, machine tool automation, auto-test equipment, telemetering by wire, and print or punch recording are explained. Five components which can be used as digital actuators and feedback devices in servo and instrumentation systems are described and illustrated.

Circle 480 on Page 17

Roller Chain Attachments

Diamond Chain Co. Inc., 402 Kentucky Ave., Indianapolis 7, Ind.—8 page bulletin—Attachments for standard and double pitch roller chains are listed in Bulletin 507. Prices and specifications for line of attachments are included. Suggestions for the proper use of the attachments are noted and illustrated.

Circle 481 on Page 17

Hydraulic Valves

Rivett Inc., Brighton 35, Boston, Mass.—12 page booklet—Four-way hydraulic valves for 2000 and 3000 psi pressures are covered in Catalog 210. Data on pipe connected, flange connected, and sub-plate mounted valves operated by lever, cam, or foot are given, with cross section views of each model. Graphs showing flow vs pressure drop are also included.

Circle 482 on Page 17

Distribution Switchboard

Distribution Assemblies Dept., General Electric Co., Plainville, Conn.—32 page handbook—Universal switchboard which can accept any combination of six different types of protective devices is described in Bulletin GEA-6627. A chart lists the types and characteristics, methods of closing, and advantages of the protective devices, and explains the system for selecting them. The panelboard and instruments are described and illustrated. Dimensions of the switchboard are given and typical arrangements shown.

Circle 483 on Page 17

Power Strap Feeder

Signode Steel Strapping Co., 2600 N. Western Ave., Chicago 47, Ill.—4 page pamphlet—The operation of Model PSF-1 which feeds vertical straps around large packages or skid loads is explained. Installation procedure is given, and horizontal and vertical tool applications are also noted.

Circle 484 on Page 17

Precision Metal Finishing

Roto-Finish Co., 3700 Milham Rd., Kalamazoo, Mich.—24 page handbook—Booklet explains how mechanical finishing processes are applied to the grinding, deburring, descaling, polishing, and coloring of metal parts. Basic machine dimensions, compartment capacities, and recommended work loads are noted. A flow diagram showing a typical system for automating metal parts finishing is also included.

Circle 485 on Page 17

Optical Parts

Bausch & Lomb Optical Co., Rochester 2, N. Y.—16 page booklet—Data on line of unmounted optical parts such as lenses, prisms, and reflectors are given in Catalog L-117. Specifications, prices, and ordering instructions are listed. A section describing special optical parts is also included.

Circle 486 on Page 17

Wire Drawing Machines

Wire Mill Equipment Div., Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.—4 page pamphlet—Intermediate, upright cone type, wire drawing machines are described in Bulletin 945-W. Oscillating multiple die holders, drawing cones, drives, automatic wire break stop, die lubrication, both motor driven and belt contact spoolers are explained. Illustrations show the machines using both types of spoolers.

Circle 487 on Page 17

Programming Study Course

Business Electronics Inc., 420 Market St., San Francisco 11, Calif.—12 page booklet—Booklet describes home-study course on programming for electronic computers. The course which consists of study assignments and workshop assignments is outlined in steps. Instruction proceeds from study of principles involving single-address machine to actual problems involving commercial data processing equipment.

Circle 488 on Page 17

Flexible Cushion Coupling

Dodge Mfg. Corp., Mishawaka, Ind.—12 page booklet—Features and construction of Para-flex flexible coupling design are explained. Numerous charts for selecting the proper coupling size are given. A cutaway view of coupling shows method of mounting on shafts.

Circle 489 on Page 17

Cam Feed Units

Edlund Machinery Co., Div. of Harsco Corp., Cortland, N. Y.—12 page booklet—Cam feed units for vertical, angular, and horizontal drilling operations are described. Mechanics and set-up of the units are explained and specifications listed. Drawings showing construction details and part numbers are included.

Circle 490 on Page 17

Quick Change Holders

Erickson Tool Co., 34350 Solon Rd., Solon, Ohio—8 page bulletin—Line of quick change holders which can be used on milling machines, boring mills, radial drills, and turret lathes is described. Dimensional drawings and specifications are noted and sketches of applications given.

Circle 491 on Page 17

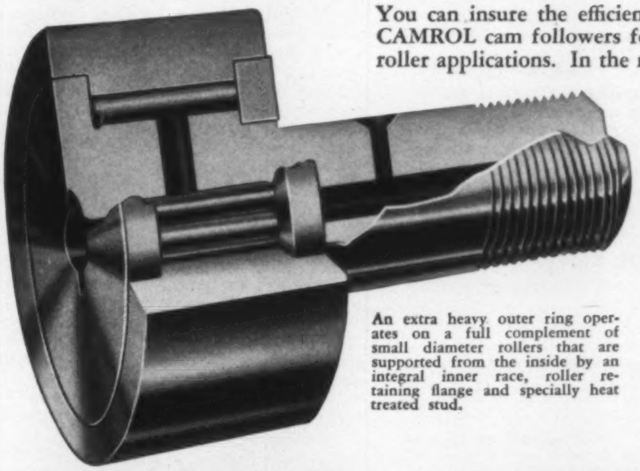
Induction Motors

Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.—16 page booklet—Line of large induction motors with ratings

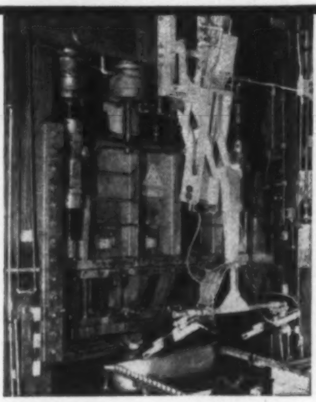
AUTOMATION TIPS by McGill

Insist on CAMROL® bearing advantages when planning your automation

You can insure the efficiency of your automated production by specifying CAMROL cam followers for cam action, track roller or guide and support roller applications. In the machinery you specify or in your own automated operations, CAMROL bearing quality guarantees dependability and longer bearing life. Their ability to withstand intermittent shock and heavy radial loads, space economy, ease of installation, simplified lubrication and balanced hardness and toughness recommends CAMROL cam followers for the critical anti-friction requirements of automation. You can eliminate downtime due to premature failures of improvised units or ordinary bearings. Insist on CAMROL CF or CYR (without stud) bearings. Both types are available in a wide range of standard sizes as are the sealed SCF and SCYR series.



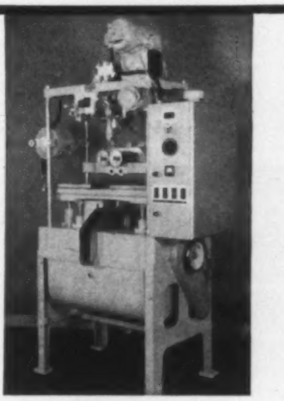
An extra heavy outer ring operates on a full complement of small diameter rollers that are supported from the inside by an integral inner race, roller retaining flange and specially heat treated stud.



Camrol bearings eliminate bearing trouble for Sahlin iron hand unloaders.

Sealed CAMROL SCF bearings on the upper arm assembly travel a confined cam track to provide direction and support for the unloading arm. Here the IRON HAND machine is shown removing 120 lb. bathtub blanks from a forming press onto a conveyor for additional automatic operations. The Sahlin Engineering Co., Inc. that supplies this unique press unloader to automate press operations, adopting CAMROL cam followers, has virtually eliminated bearing replacement under all conditions.

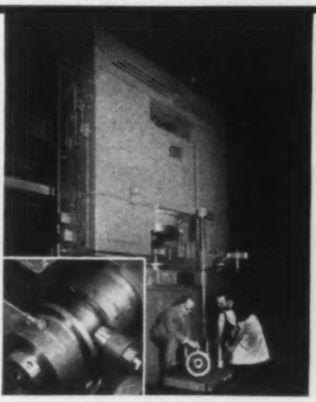
SEND FOR CATALOG 52-A



Camrol bearings show no apparent wear after three years use in automatic packaging machines.

The Kartridg-Pak Machine Co. uses McGill CAMROL bearings in the main drive mechanism of a packaging machine that also forms the container from thermoplastic film. This machine automatically forms, fills and closes 1800 packages of food or other semi-fluid products per hour. Dependability and accuracy of the free rolling and easily lubricated cam followers help guarantee the efficiency of these automatic operations.

After three years of use in this application, the CAMROL bearings show no apparent wear.



Camrol bearings assure greater speed and accuracy in shear-speed shapers.

Michigan Tool Co. uses CAMROL CF and CYR bearings in Shear-Speed Shapers that automatically produce gears up to 20 inches in diameter and up to 6 inch widths in only 13 minutes. These bearings, acting as cam followers, accurately control the feed of all cutting tools simultaneously and relieve these tools from the work on return strokes. They insure dependable, precision performance for automatic operations at high production speeds in these largest production gear cutting machines ever built.

Insure performance with McGILL®

MULTIROL® GUIDEROL® CAMROL

Precision Needle Bearings

McGILL MANUFACTURING COMPANY, INC., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

from 150 to 1250 hp is covered in Bulletin 1950. Construction details of the protective features offered by various types of enclosures are noted. Cutaway drawings and illustrations show the protective advantages of the units.

Circle 492 on Page 17

Automatic Controls

General Controls Co., 801 Allen Ave., Glendale 1, Calif.—44 page catalog—Data on counting devices, switches, electric valves, actuators, relays, limit controls, time switches, and similar items which can be used as building blocks in developing automated systems are given in automation controls catalog 1957-58. Specifications and applications are noted.

Circle 493 on Page 17

Sculpture Machines

Colonial-Romulus Div., Colonial Broach & Machine Co., Parkgrove Station, Detroit 5, Mich.—4 page pamphlet—Tracer-controlled sculpture machines for contour and profile milling are discussed in Bulletin CRS-57. Components of the machine are described, milling speeds and feeds given, and features listed. Application photos showing the use of the machines in die work are included.

Circle 494 on Page 17

Press Conversion Assemblies

E. W. Bliss Co., 1375 Raff Rd. S. W., Canton, Ohio—16 page booklet—Modernization and conversion assemblies for older straight side and gap frame double crank presses are described in Bulletin 46. Various kits, which modernize the units by adding features such as die cushions to extend press range in draw work, modern pneumatic-friction clutches to increase production, and driveshaft roller bearings which require less maintenance and permit heavier press loads, are listed.

Circle 495 on Page 17

Pipe Line Filters

Dollinger Corp., Rochester 3, N. Y.—8 page bulletin—Filters for air, corrosive, and other gases are described in Bulletin 200. Operating principle and applications are noted. Cutaway views show the advantages of the filters.

Circle 496 on Page 17

Subminiature Relays

Radio Corp. of America, Bldg. 15-1, Camden 2, N. J.—12 page booklet—Line of relays which are designed for critical industrial requirements is described. Features and specifications are noted, and contact and vibration ratings for various models are listed. Numerous diagrams are also given.

Circle 497 on Page 17

Check Valves

Techno Corp., 16-30 W. 5th St., Erie, Pa.—4 page pamphlet—Valves for gas, air, and other fluid lines are described. Operating principle is explained, dimensions and features listed. Charts showing flow plotted against pressure drop are also given.

Circle 498 on Page 17

Bulk Pneumatic Conveying

Fluor-Hartmann Div., Fluor Products Co., Whittier, Calif.—24 page handbook—Bulletin GFH-1157 covers pneumatic conveying systems, ash handling systems, prime movers, and dust and fume collection systems. Mechanical conveying components are also described. The various systems are explained, their applications noted, and sketches showing proper arrangements are given.

Circle 499 on Page 17

Printed Circuits

Printed Electronics Corp., North St., Natick, Mass.—4 page pamphlet—Printed circuitry and the process for plating holes is explained. Data on materials, specifications, and design tolerances are given. Also included are details on how to use the equipment for production of printed circuits in the user's plant.

Circle 500 on Page 17

Slide Assemblies

Russell T. Gilman Inc., 624 Beech St., Grafton, Wis.—2 bulletins—Light and heavy duty slide assemblies are covered. Bulletin 125 describes and illustrates line of slides which are standard components for special machines. Construction features are also noted. Specification sheet 125-1,10 lists dimensions and model numbers. Sketches of various models are included.

Circle 501 on Page 17

Digital Tape System

Instrumentation Div., Ampex Corp., 934 Charter St., Redwood City, Calif.—16 page booklet—Magnetic-tape input/output system for digital computers and related equipment is described. Manner of obtaining transfer rates up to 90,000 characters per second is related. Components of the system are explained and illustrated, and specifications listed.

Circle 502 on Page 17

Motor Control

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.—8 page bulletin—High voltage starters for 2300 and 5000 volt motors are described in Bulletin 14B8507. Booklet explains how the components of the control are separately tested to give maximum performance. Illustrations of the unit's protective features are also given.

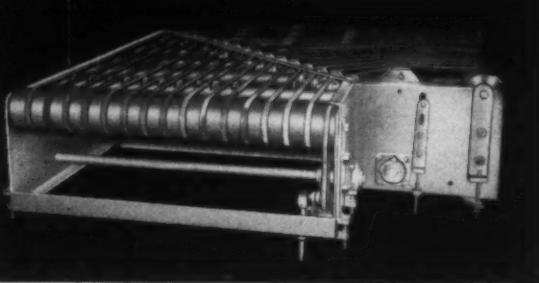
Circle 503 on Page 17

Automatic Machine Tools

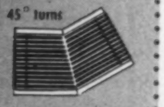
Jones & Lamson Machine Co., Springfield, Vt.—22 page booklet—Line of machines is covered in Catalog 57. Various models of automatic lathes, boring machines, and thread and form grinders are described and illustrated. Company's approach to automation is stated and illustrated by examples of installations.

Circle 504 on Page 17

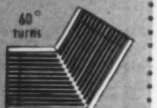
NEW STEWART-TURN
the 90° turn that really works!



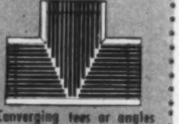
A few other applications of versatile Stewart-Turns.



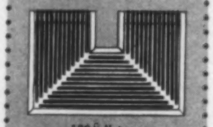
45° turns



60° turns



Converging tees or angles



180° U-turns

Turning 90° corners is no longer a problem or bottleneck in material handling systems. The unique Stewart-Turn moves material around corners as easily as in a straight line! No rollers to stick, tight corners to jam or deflectors to damage the material being moved. Never before has this been possible!

The Stewart-Turn is a series of narrow-faced belts, running in grooved pulleys, banked for constant contact with the material in motion. A slight differential in speed between the bank of belts produces a positive turning action, with belts spaced to carry small as well as large or long articles. Belt friction reaction to turning has been eliminated.

Stewart-Turns, as well as all Stewart-Glapat material handling equipment and conveyors, are CUSTOM DESIGNED TO YOUR JOB. If you are looking for advanced engineering thinking for your material handling or automation problems, WRITE STEWART-GLAPAT TODAY, and ask for complete details on the sensational, new Stewart-Turn!

STEWART-GLAPAT Corporation
1645 Moxahala Avenue, Zanesville, Ohio

Circle 714 on Page 17

Industrial Solenoids

Detroit Coil Co., 2435 Hilton Rd., Ferndale 20, Mich.—6 page pamphlet—Various types of solenoids, including an oil immersed solenoid, are described in Bulletin 572. Features, dimensions, and force characteristics are covered, and dimensional drawings of various models included.

Circle 505 on Page 17

Magnet & Wound Field Motors

Globe Industries Inc., 1784 Stanley Ave., Dayton 4, Ohio—10 page bulletin—Four models of miniature dc permanent magnet and wound field motors are described. Interchangeable spur and planetary gear boxes, governors, and radio noise filters are also covered. Performance, specifications and technical data are given.

Circle 506 on Page 17

Load Switch

J.I.C. Electric Co., 19255 W. Davison, Detroit 23, Mich.—4 page pamphlet—Switch, which operates on the input characteristics of an electric motor, is applicable on drilling, milling, and grinding operations. Additional applications are mentioned, and the features noted. Installation instructions are also given.

Circle 507 on Page 17

Hydraulic Pumps

Kobe Inc., 3040 E. Slauson Ave., Huntington Park, Calif.—12 page booklet—Pumps which can be used in high-pressure, high-temperature, and continuous duty applications for the operation of hydraulic test equipment, molding presses, and lubricating systems are described in Bulletin 1157. Various features are noted and illustrated, pressure ratings of the plunger type pumps are also listed.

Circle 508 on Page 17

Magnetic Chucks

O. S. Walker Co. Inc., Worcester 6, Mass.—20 page booklet—Catalog 58 covers magnetic rectangular chucks, vertical chucks, swiveling chucks, rotary chucks, and, also, demagnetizers. Specifications and illustrations for the various models are given. Service hints for electromatic rectifiers are mentioned and a section is devoted to control equipment.

Circle 509 on Page 17

Resistance Welders

Taylor-Winfield Corp., Warren, Ohio—8 page bulletin—Resistance welders designed to mass-produce electrical contact, conductor, and terminal assemblies are described in Bulletin 8-313. Operations of various types of units are explained. Illustrative examples of special welding equipment and tooling required for mechanized handling are also included.

Circle 510 on Page 17

Cartridge Heating Unit

Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.—6 page pamphlet—Data on electric heating unit which is suitable for a wide range of industrial applications are given in Bulletin 365. Specifications, prices, and illustrations of the various units are noted. Also included are graphs and information on how to select the proper type and size unit, the proper fit, and how to determine watts density required for a particular installation.

Circle 511 on Page 17

Precision Presses

Precision Welder & Flexopress Corp., 3520 Ibsen, Cincinnati, Ohio — 8 page bulletin — The feed mechanism, speed control and clutch, crankshaft, and operating controls of both C type and straight side presses are described in Bulletin AFP-101. Illustrations of various models are given and specifications and features of the C type presses from 15 to 75 tons, and the straight side presses from 75 to 200 tons are included.

Circle 512 on Page 17

Combustible Gas Analyzer

Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.—8 page bulletin—Instrumentation for centralized process control and industrial safety is described. The principle of operation and special features of the analyzer are explained. Components such as a monitor unit, control unit, remote head assembly, station selector, and pump assembly which are combined to form three basic systems show the operating flexibility to meet a variety of needs.

Circle 513 on Page 17

Pyrometer Supplies

Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Avenues, Philadelphia 44, Pa.—52 page catalog—Various models of base metal thermocouples, sensitive thermocouples, and special purpose thermocouples are described and illustrated in Catalog G100-8. Mounting attachments and components for thermocouples are also noted. One section gives data for the proper selection of thermocouples.

Circle 514 on Page 17

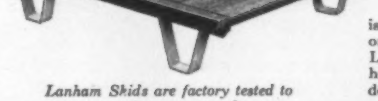
Eccentric Gear Presses

Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio—8 page bulletin—Line of eccentric-gear, straight-side presses is described in Bulletin 13301. Application data, safety features, and construction details are noted. Also included is a chart listing specifications on stroke, shut height, slide adjustment, strokes per minute, and bed, bolster, and slide areas for units ranging in capacity from 300 tons through 2000 tons.

Circle 515 on Page 17

Plastic Gate Valve

Vanton Pump & Equipment Corp., 201 Sweetland Ave., Hillside, N. J.—4 page pamphlet—Valves which are suitable for applications where lines conveying corrosive and abrasive liquids must be chemically free of contamination are described in Bulletin 42.0. Design details are given, and also included are drawings showing the advantages of the straight-through flow



NEW CATALOG

shows how to choose the right SKID or SKID BOX for your job

Lanham Skids are factory tested to assure capacity use, year after year.

When materials handling equipment is designed for a specific job, whether storing or transporting, it increases efficiency . . . LOWERS COSTS. Our new catalog shows how to order Lanham Skids and Skid Boxes designed to handle any type or shape of commodity. Write today for Catalog No. LS-58.

Rollaway Jacks & Semi-Live Skids

LANHAM
FOR LIFETIME

THE LANHAM CO.
808 Mississippi River • Keokuk, Iowa

Sectional Bins

Circle 715 on Page 17

feature and the throttling control designed into the valve.

Circle 516 on Page 17

Instrumentation & Control

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.—8 page bulletin—Reactor power control, reactor nuclear instrumentation, reactor coolant, instrumentation, and radiation monitoring are described in Bulletin B-7233. How the electrical systems are co-ordinated into functional groupings is also explained. A schematic diagram showing a typical pressurized-water power reactor is included.

Circle 517 on Page 17

Shaft Mounted Drives

Falk Corp., Dept. 255, 3001 W. Canal St., Milwaukee 1, Wis.—32 page catalog—Line of shaft mounted drives suitable for applications requiring from ½ to 50 hp and from 420 to 5 rpm output speed is described in Bulletin 7100. Construction features are explained and data are given on how to select the proper size and ratio of a unit. Also included are two pages of photos of actual installations.

Circle 518 on Page 17

Industrial Offset Printing

Jas. H. Matthews & Co., 3945 Forbes St., Pittsburgh 13, Pa.—5 page pamphlet—Five offset printing units which can be used with steel, plastic, and aluminum material are described. Booklet includes data on the dual offset can imprinter, small diameter tube marker, in-line small parts printer, in-line offset printer, and multiple steel band offset printer. Illustrations of the machines are also given.

Circle 519 on Page 17

Seals and Valves

Fawick Airflex Div., Fawick Corp., 9919 Clinton Rd., Cleveland 11, Ohio—6 page pamphlet—Special seals which are used to transmit air, liquid, or gases under pressure or vacuum from a stationary source into a rotary shaft, are described in Bulletin ML-177. Functions, applications, and dimensions are noted. One section also discusses how quick release valves are used to provide evacuation of pressurized air from pneumatic systems.

Circle 520 on Page 17

Metal Processing Machines

Stanat Mfg. Co. Inc., 500 Shames Dr., Westbury, L. I., N. Y.—16 page booklet—Metal processing machines such as rolling mills, gang slitters, wire flattening lines, and roller levelers are described in Bulletin 1057. Photographs of numerous applications and installations are given.

Circle 521 on Page 17

Riveting

Judson L. Thomson Mfg. Co., Waltham 54, Mass.—42 page handbook—Various kinds of rivets are described, applications, and advantages noted. Numerous types of automatic rivet-setting machines are illustrated and dimensional data given. Purchasing information is also noted.

Circle 522 on Page 17

Transistor Data Chart

Kahle Engineering Co., 1313 Seventh St., N. Bergen, N. J.—8 page bulletin—Manufacturer of automatic semiconductor machinery has prepared a chart which features up-to-date technical specifications and application data for 500 commercially available transistors. Type, class, typical operation, and maximum ratings are included in the charts.

Circle 523 on Page 17

Chucking Equipment

Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.—23 page booklet—Chucks, collets, power chuck wrenches, and air cylinders are covered in Bulletin 1117-C. Specifications and design features of the various units are given. A section is devoted to special work-holding equipment, and is illustrated with photos of applications.

Circle 524 on Page 17

Combustion Control

Hays Corp., Michigan City, Ind.—12 page booklet—Packaged combustion control and its application in the steam generation field is explained in Bulletin 57-1088-239. Ten different systems of control available in packaged form are described. A chart on program control, a panel outline, and piping and wiring details are also included.

Circle 525 on Page 17

Hydraulic Pump Strokers

Oilgear Co., 1571A W. Pierce St., Milwaukee 4, Mass.—8 page bulletin—The operation of an electro-hydraulic pump stroker, the pump stroker command system and its circuitry is discussed in Bulletin 4. Electric hand operated controls, limit switches, and preset controls are described. Numerous schematic diagrams are given.

Circle 526 on Page 17

Flow Meters

Bristol Co., Waterbury 20, Conn.—22 page booklet—Bulletin F1607 gives engineering data on differential pressure type flow meters. Information on the selection, sizing, and installation of the meters is also noted. Equations for calculating throat diameters, and flow rates, and finding manometer ranges are listed with tables of data for flow calculations included.

Circle 527 on Page 17

Pneumatic Equipment

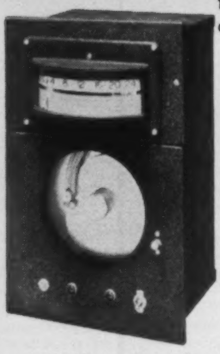
U. S. Gauge, Div. of American Machine & Metals Inc., Sellersville, Pa.—16 page booklet—Line of indicating controllers for automatic control of pressure or temperature, transmitters for pressure or temperature indication, and receiver gages is described in Catalog 510. Control actions are explained, and tables

NOW compact, dependable, economical, guaranteed

Completely AUTOMATIC PROCESS CONTROL

of TIME-TEMPERATURE CYCLE

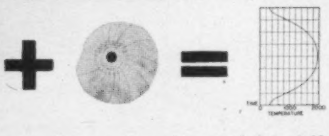
through off-on or proportioning, high limit or stepless control action with secondary switching provisions!



Gardsman Model JG Series

Versatile, Indicating, Pyrometric

PROGRAM CONTROLLERS



- Maintains extremely accurate time-temperature relation through broad range.
- Automatically repeats identical cycle for *thousands* of operations. By replacing cam the same instruments may be used for different time-temperature programs.
- Works with choice of 4 types of basic control.
- Requires no warm-up, tuning; less maintenance.

Write for Model JG Series and Data on our complete line.

4355DW. MONTROSE AVENUE, CHICAGO 41, ILLINOIS

British Plant: WEST INSTRUMENT LTD.
52 Regent St., Brighton 1, Sussex
Represented in Canada by Upton, Bradeen & James

WEST *Instrument* CORPORATION

Circle 717 on Page 17

of ranges, element characteristics, and bulb lengths are noted.

Circle 528 on Page 17

Dehumidifiers

Anders-Lykens Corp., Div. of Milton Roy Co., 1328 E. Mermaid Lane, Philadelphia 18, Pa.—4 page pamphlet—Adsorptive type, automatically regenerated air dryers with capacities to 125 cfm at 90 F and 100 psig are discussed in Bulletin 857. Operation of the air dryers is explained, ordering information given, and a specification selection table included.

Circle 529 on Page 17

Automatic Test Equipment

Electronics Div., Dit-Mco Inc., 911 Broadway, Kansas City 5, Mo.—2 brochures—A testing system which is built around company's automatic test equipment is described in first booklet. The test procedure, pre-production planning, and test methods are described. Second booklet describes the company services offered to industry to aid in setting up the proper testing system.

Circle 530 on Page 17

Gear Sets

Cone-Drive Gears, Div. of Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.—16 page booklet—Line of worm gearing, available in matched sets, is covered in Bulletin 700-C. Worms with single or double-extended shafts, and hub type, rim type, or flange type gears are described. Tool charts, horsepower ratings, backlash tolerances, and lubrication data are listed.

Circle 531 on Page 17

Precision Ball Bearings

Barden Corp., Danbury, Conn.—12 page booklet—Data which are suitable in the application of precision instrument bearings are discussed in booklet "Ball Bearing Yield and System Isoelasticity." Background information on radial and axial play, axial take-up and preloading, and isoelastic bearings is given. The effect of temperature differentials on selection of preload arrangement is also described.

Circle 532 on Page 17

Industrial pH Equipment

Process Instruments Div., Beckman Instruments Inc., Fullerton, Calif.—8 page bulletin—Device which is used in measuring and control of chemicals, metals, pharmaceuticals, and pulp and paper processes is covered in Bulletin 5400. Instruments, electrodes, and accessories are described and illustrated. Specifications and ordering instructions are also given.

Circle 533 on Page 17

Immersion Processing

Frederic B. Stevens Inc., 1800 Eighteenth St., Detroit 16, Mich.—14 page booklet—Line of automatic barrel plating and processing machines for zinc, nickel, copper, and tin is described. Features of the machines which are capable of plating, cleaning, washing, phosphating, and stripping parts are noted. Numerous illustrative examples of applications are included.

Circle 534 on Page 17

Flow Meters

Hagan Chemicals & Controls Inc., 323 Fourth Ave., Pittsburgh, Pa.—8 page bulletin—Ring Balance Meter which can function as a recorder, indicator, or integrator used in the measurement of gases, vapors, and liquids is described in Bulletin PM 10002. Performance and specification data are listed. Data on accessories which can be interchanged for various applications are also given.

Circle 535 on Page 17

Pressure Transmitter

Fischer & Porter Co., 490 Jacksonville Rd., Hatboro, Pa.—4 page pamphlet—Force-balance differential pressure transmitter is the subject of Bulletin 10B1465. The unit features measuring circuit parts completely sealed off in silicone oil, and adjustable damping directly within the measuring circuit. Specifications and performance data are also noted.

Circle 536 on Page 17

Gain the economies of

AUTOMATION!

NEW chain-driven FEDERAL dial feeds

Model 3—
26-ton capacity

Federal Chain-driven Dial Feeds eliminate the need for specialized and more costly machinery. With automatic feeds and ejectors, these rugged presses step up production three to six times. Special jigs make their application virtually unlimited. Rotating table is driven by automotive, timing gear-type chain and provides 50% greater working area for the operator. Index and work plates operate on thrust bearings. Shot pin with tapered bushing assures absolute accuracy at each index. Rugged. Precision built. Eight sizes. Six to eighty ton capacities. See your dealer or write today.

FEDERAL PRESS COMPANY, 802 Division St., Elkhart, Indiana

FEDERAL DIAL FEED PRESSES

33 Years' Experience in Dial Feed Engineering and Construction

Circle 718 on Page 17

AUTOMATION abstracts

PRESS CONTROL VALVING FOR SAFE OPERATION

By ANDREW B. HUNTINGTON
Chief Engineer
Ross Operating Valve Co.
Detroit, Mich.

POWER PRESSES, because of their function, present some major industrial accident hazards. The most disastrous of these hazards can be accidental press stroking, often referred to as a "press-repeat." This hazard may be created unintentionally, or it can result from some mechanical, electrical, or pneumatic failure in the press control system. My purpose is to describe briefly, from a safety standpoint, the various methods that can be used to pneumatically operate a press clutch or brake, or a combination clutch-brake device.

The application of mass production principles in the metalworking industry has brought about the development of fast-acting pneumatic clutches and brakes for all types of power presses. In the usual device of this type, the clutch is air-pressure engaged, spring disengaged, and the brake is spring engaged, air-pressure disengaged. This provides a very desirable fail-safe type of arrangement in the event of loss of primary air pressure.

Single Valve Control

To control the air power which can disengage the brake and engage the clutch, a solenoid operated, 3-way air valve is usually used. A piloted poppet valve of this type is shown in *Fig.* 1.

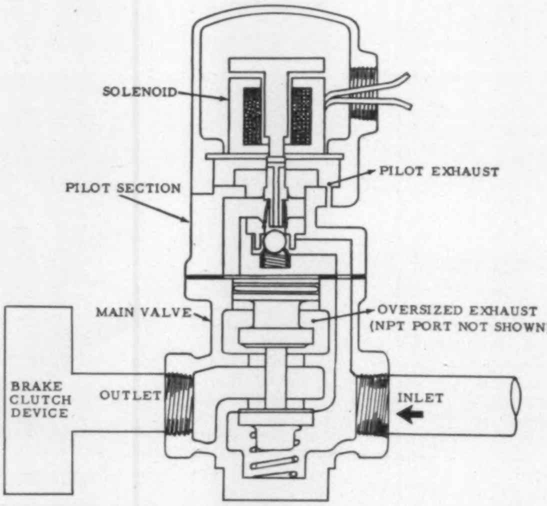
This is a 3-ported valve having an inlet, an outlet, and an exhaust connection. It can also be described as a normally closed, 2-position valve. In one position, with the solenoid de-energized, the inlet is spring and/or pressure closed, and the outlet is open to exhaust. In its other position, with the solenoid energized, inlet pressure is open to the brake-clutch device, and the exhaust is closed. Here again, a very desirable fail-safe feature is provided in the event of loss of primary electrical power, in that the valve will then close. Obviously, a valve of this type could also be used to control a single-acting cylinder which, in turn, could operate a mechanical or positive type brake-clutch mechanism.

To reduce electrical power requirements, allow higher maximum cycling rates without unduly sacrificing life, and to improve over-all valve response time, press valves are usually air-piloted rather than direct solenoid operated.

Where a single valve is used to control a clutch, failure of the valve to return to its normal or inlet-closed position at the proper time, may cause a press-repeat. I say, *may* cause a press-repeat, because if the inlet orifice partially closes while the exhaust orifice remains partially open, the exhausting capacity of the valve may be enough greater than its pressurizing capacity to reduce the receiver pressure to a safe value. It should be noted that most valves for this application have an oversized exhaust port to assist such action.

In a direct operated solenoid valve, an unsafe valve condition can be caused by freezing of the solenoid in the energized position, return spring or linkage failure, or by internal mechanical interference. In the more usually employed solenoid actuated, pilot operated valve, mechanical failure in the pilot section is an additional possibility. Note that this discussion neglects any effect of malfunction in the electrical control external to the solenoid.

To reduce the possibilities of valve failure due to solenoid and pilot section malfunction, Ross Operating Valve Co. several years ago developed and marketed a 3-way, normally closed press valve that has a clapper type solenoid, a 3-way normally closed pilot



NOTE: VALVE SHOWN DEENERGIZED

Fig. 1—Solenoid actuated, pilot operated 3-way pneumatic valve of a type often used to actuate clutch-brake of a power press. Freezing of solenoid in energized position, spring failure, or mechanical interference in valve may cause unsafe press-repeat action.

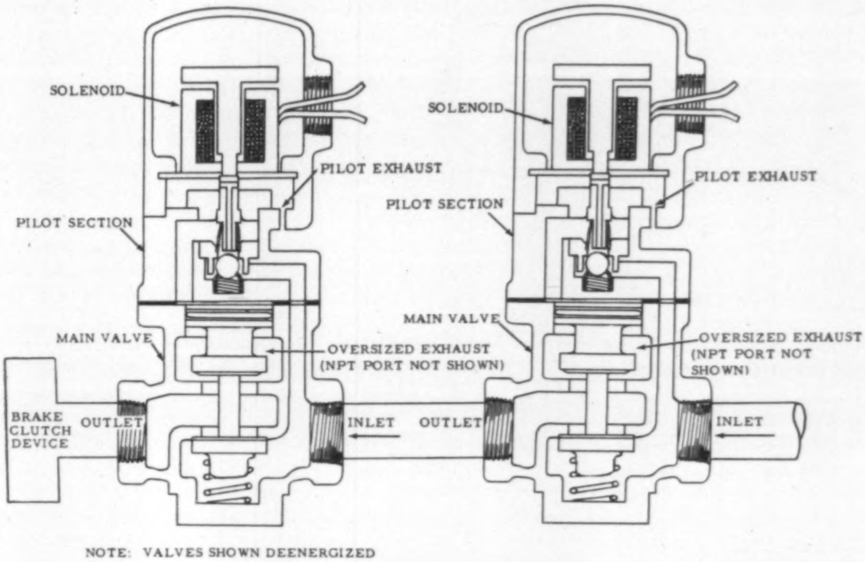


Fig. 2—Use of two valves of the type shown in *Fig. 1*, connected in series pneumatically and in parallel electrically, improves safety of operation of press. Should one valve remain open when its solenoid is deenergized, other valve will probably operate correctly, exhausting clutch-brake device and preventing press-repeat.

section, and an oversized exhaust port. Normal wear on this type of solenoid, or coil burn-out, is very unlikely to cause the solenoid armature to freeze or hang up in the unsafe or energized position. In addition, the pilot section of this valve has no spring. The solenoid and the pilot section are further arranged so that gravity, as well as pressure, will assist return of both the pilot and the solenoid to the *safe* position upon control circuit opening. Many high-reliability press valves of this type are used in automotive metalworking shops.

Multiple Valve Arrangements

Some presses utilize one simple 3-way normally closed valve for the clutch, and another for the brake.

"AIRGRIT" MARKS THESE PRODUCTS
FAST • GENTLY • PERMANENTLY

learn how it can mark for you

IN LINE MARKING

Latest developments have made possible fully automatic "Airgrit" units designed to mark parts in a moving production line. This advancement opens an entire new field of "Airgrit" applications in the age of automation.

INDEPENDENT MARKING STATION

Airgrit units are ideal for both male and female operated marking stations, to mark a host of delicate parts at high production rates. Depending on conditions, as high as 500 parts per hour can be marked on the Airgrit unit.

SPECIAL PURPOSE UNITS

Many awkward and hard to mark products require a specially designed and constructed Airgrit unit. Cases like these demonstrate the versatility of the airgrit principle of marking for practically any industry.

Operating on the forced-blast principle, the Matthews Airgrit is a proven production marking machine for glass, ceramics, polished metals and precision finishes and parts (like the radio tube above). Tiny particles of grit blown through a rubber mask mark delicate, precision or thin-walled parts without distortion, without danger of fracture, without creating damaging stress or strain. There's a place for the Airgrit in your operation. Find out more today by writing for complete information.

JAS. H. MATTHEWS & CO.
3945 Forbes Ave., Pittsburgh 13, Pa.
OFFICES IN PRINCIPAL CITIES
WRITE, CALL OR TWX PG 424

Circle 719 on Page 17

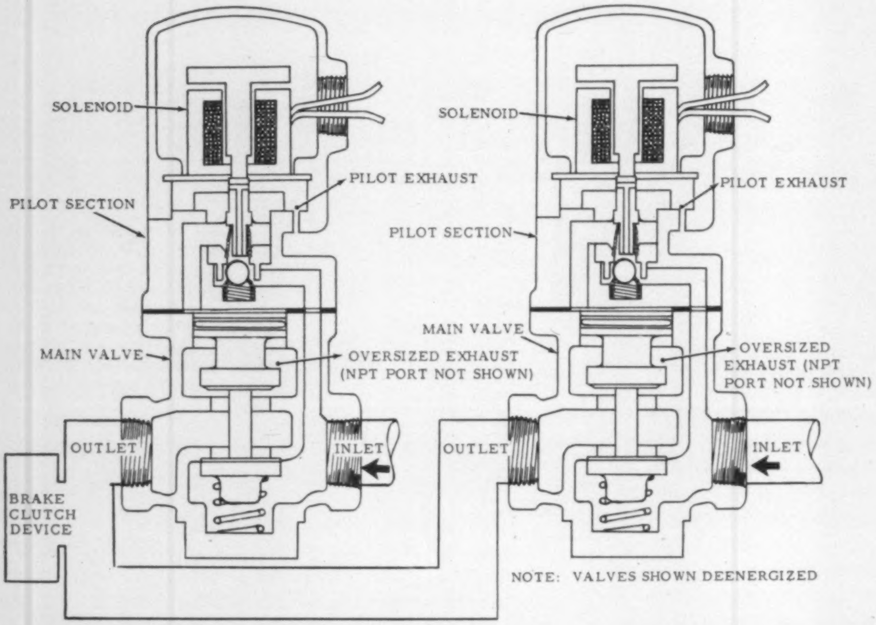

SOLENOID
PILOT EXHAUST
PILOT SECTION
MAIN VALVE
OVERSIZED EXHAUST (NPT PORT NOT SHOWN)
OUTLET
INLET
BRAKE CLUTCH DEVICE
SOLENOID
PILOT EXHAUST
PILOT SECTION
MAIN VALVE
OVERSIZED EXHAUST (NPT PORT NOT SHOWN)
OUTLET
INLET
NOTE: VALVES SHOWN DEENERGIZED

Fig. 3—Parallel connection of two valves, both pneumatically and electrically, as shown, could lead to unsafe press-repeat on failure of one valve to exhaust. Large exhaust ports on valves improve chances that operating valve will properly exhaust the system.

This provides a slight safety improvement over use of a single valve, due to the improbability of the two valves failing simultaneously. If the clutch valve remains sufficiently open at the end of a stroke, press advancement is powered, but is opposed by the brake which is also engaged. If the brake valve remains sufficiently open at this portion of the cycle, subsequent press advancement is dependent upon the kinetic and potential energy provided for coasting.

There are several other methods, beyond good preventive maintenance, of making pneumatic valving safer for both the press operator and the equipment.

Westinghouse
CYPAK

These methods rely primarily on the doubling up of valve units, so that failure of any one unit will not unduly jeopardize safety. The possibility of simultaneous failure of both units causing complete loss of safety is then considered extremely unlikely. If the air flows through the two units in succession, the units may be said to be in series pneumatically. If the air flows through the two units simultaneously, the units may be described as being in parallel pneumatically.

One of these improved safety methods is to use two 3-way, normally closed valves in series pneumatically and in parallel electrically, *Fig.* 2. With this arrangement, when either of the valves malfunctions and remains open in the absence of the proper electrical signal, the other valve, operating properly, will exhaust the brake-clutch device and there will be no press - repeat. Unfortunately, in this method, there is little audible or visual indication of a malfunctioning valve, and one must therefore rely on periodic and careful inspection procedures to make sure that both units are operating properly. Obviously, with this setup, whenever one of the units is stuck in the energized position, safe press operation then depends entirely on the proper operation of the other unit.

To overcome the principal lack of safety in the simple *series* method, one press manufacturer has used two valves in series, each modified to include a valve-position indication stem, in combination with limit switches. With this added and highly desirable feature, the individual valve actions can be electrically indicated and interlocked. Adequacy of the improved safety here depends primarily on the ability of the electrical circuit to prevent further press cycling whenever one of the limit switches indicates something is wrong. Although it may be difficult to obtain mechanically operated switches with sufficient life for this application, it may be possible to substitute magnetically operated proximity switches.

A second and more complicated variation of the series method is a multiple, or dual-unit valve. This item consists of a 3-way normally open "safety-unit," a 3-way normally closed "operating unit," a safety verifier, a permissive pilot, and various interconnecting passages. The safety unit is ahead, or upstream, of the operating unit, and in series with it. The pilot solenoids are in parallel electrically. The safety unit is a standby type and has a feedback operated lock-out feature. In the event that pressure remains momentarily on the brake-clutch in absence of the proper electrical signal, line pressure trips the safety, or standby, unit and exhausts the pressure from the brake-clutch. Resetting of this valve can be done after removing the inlet pressure on the safety unit. The manufacturer recommends that this be done with a manual 3-way valve upstream of the dual-unit valve. A special electrical test circuit can be used to safety-check this valve.

Another simple method of controlling clutch action consists of using two 3-way normally closed solenoid valves in parallel both pneumatically and electrically, *Fig.* 3. With this arrangement, a hazardous condition exists whenever either of the two valves malfunctions

Westinghouse CYPAK makes automatic car storage a coming and going thing

At Chrysler Corporation's Newark, Delaware, assembly plant, seven CYPAK* static control systems control the storage of auto bodies. CYPAK remembers where the Plymouth and Dodge shells are stored, and with just the pressing of a button, returns them in a pre-selected order.

This advanced control system is in everyday operation, helping this brand-new plant assemble autos. CYPAK was chosen because it eliminates maintenance, operates economically and requires little space.

To find out what CYPAK can do for you, call your Westinghouse representative.
Or, write Westinghouse Electric Corporation,
3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pa.

* Trade-Mark J-22093

POWER-UP starts with CONTROL

YOU CAN BE SURE...IF IT'S Westinghouse

Circle 710 on Page 17

If *You* want to PRODUCE MORE

... develop *Your*

PARTS FEEDING

with VFC

BASIC

EQUIPMENT

MOTIVATION...

...AUTOMATION

VFC HAS A CHARTED COURSE THAT WILL HELP YOU!

The real impelling force at VFC, aside from developing better parts feeding equipment, is how to help industry produce more.

When one or more parts are scheduled for a rendezvous, you need parts feeders and VFC's technical knowledge of how they can be adapted to your product or production line. No matter what direction your business takes, use VFC's parts feeding know-how as the motivation to automation.

TECHNIQUES FOR...

SIZES • SHAPES • MATERIALS

This tremendous storehouse of parts feeding information is available to you—make use of it and produce more—automatically. If you have a parts feeding job pending, the chances are the answer is in your VFC Sales Engineers Data Book, ask about it.

VFC..
FEEDING
DATA
BOOK

VIBRATORY FEEDER COMPANY

32nd and BRANDES STS., ERIE, PA. • PH 4-6320

Division of Automation Devices, Inc.

and remains open in the absence of the proper electrical signal. This condition can be somewhat alleviated by providing each valve with an oversized exhaust port.

If the de-energized valve that is operating properly can pass sufficient air from the malfunctioning valve to exhaust, the pressure at the common outlet or clutch connection may be reduced enough to disengage the clutch and engage the brake. If the press action does not indicate a valve failure, it may be noted audibly after completion of a valve cycle. Normally, there should be no sound of air exhausting.

One dual, or multiple-unit valve of the parallel type consists of two 3-way, normally closed valve elements with a common inlet, a common outlet, and two oversized exhaust ports. To electrically lock out the valve and prevent continued press operation when one of the valve elements has failed, a pressure switch connected to a reservoir ahead of the valve inlet can be used to signal loss of air to exhaust.

The Ross Lifeguard valve, *Fig.* 4, exemplifies another design of a dual-unit valve of the parallel type. It consists of two identical 3-way normally closed units, each with its own pilot section and solenoid, in parallel both pneumatically and electrically. The units have a common ¾-inch inlet port, a common 1-inch outlet port, and two 1-inch interconnected exhaust ports. This design provides the desirable safety feature of an exhausting orifice considerably larger than the pressurizing orifice. The two 3-way normally closed pilot sections

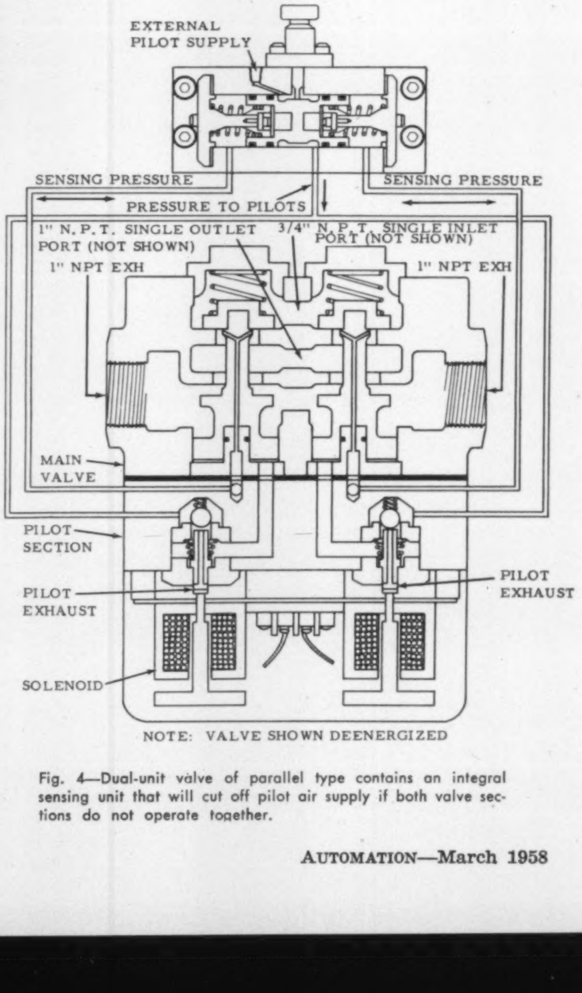


Fig. 4—Dual-unit valve of parallel type contains an integral sensing unit that will cut off pilot air supply if both valve sections do not operate together.

STAMPINGS

Produced economically in our modern plant for:

AUTOMOTIVE, INDUSTRIAL EQUIPMENT, DOMESTIC APPLIANCE, AGRICULTURAL INDUSTRIES AND OTHERS; will boost your output at material savings.

Our production, engineering and toolroom facilities are geared to the volume usage of *your* industry.

Send us your inquiries

LANSING STAMPING COMPANY
1157 So. Pennsylvania
Lansing 4, Michigan
Established 1914

Circle 726 on Page 17

AIRMATIC
Small Bore Cylinders

Available: In sizes of ⅜", ½", ¾", 1", 1⅛" and 1½" with single threaded end, double threaded end or clevis end.

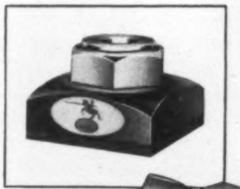
For these mountings:
Trunnion Foot Flange Clevis

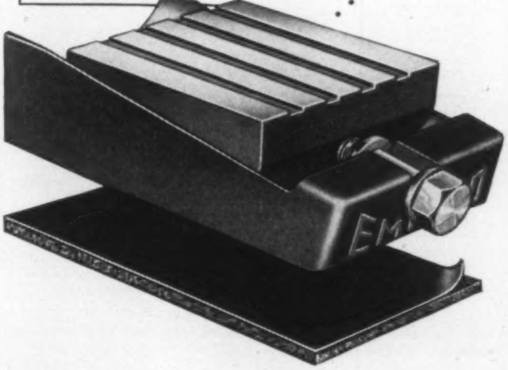
WRITE FOR BULLETIN

AIRMATIC VALVE INC.
7317 Associate Ave. Cleveland 9, Ohio

Circle 727 on Page 17

*dependable machine support . . .
begins with
an*
EMPCO
leveling jack





Dependable, easy-to-adjust Empco Leveling Jacks provide a solid foundation for machine tools, large surface plates, automation lines, tool room and production equipment of all types. Periodic leveling? It's a matter of seconds! Simply turn hex-screws . . . your machine is set level . . . kept level!

Combined with Vi-Sorb Mounting Pads, Empco Jacks control vibration within the machine itself, reduce transmitted noises, retard machine creepage and frequently eliminate the need for anchor bolts!

Support? Up to 10 tons each! Available in six styles, 25 models . . . an Empco Jack to meet every job requirement. Set your machines level, keep them level. Reduce machining costs with Empco Jacks!

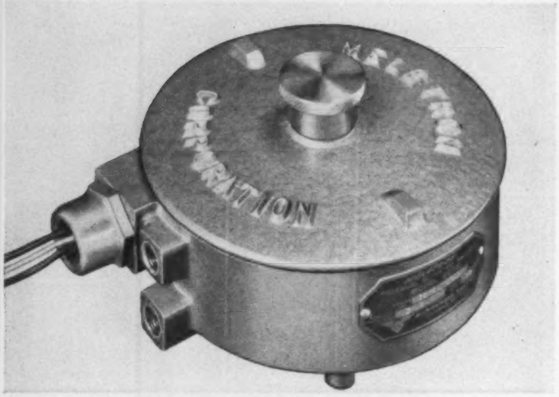
INQUIRE TODAY ask for Bulletin No. 100

*The Enterprise Machine Parts Corp.
2738 Jerome Ave., Detroit 12, Michigan*

EMPCO LEVELING JACKS

Manufacturers of Automatic Production Machines, Fixtures, Machine Parts

Circle 725 on Page 17



MELETRON

DIFFERENTIAL SWITCH

senses pressure differences from .45 to 45 inches of water

Used in hopper level indicating, on oil burner blower safety control, in instrumentation or similar applications where it is necessary to sense a pressure difference of .45 to 45 inches of water between a variable and a reference pressure. The reference pressure may be as high as 30 P.S.I.

WE BUILD IN	WE DON'T USE
EXTREME ACCURACY and DEPENDABILITY maintained during operating life due to direct acting design	**LINKAGES & BEARINGS** which as they wear, make the setting of the pressure switch drift.
OPERATION IN ANY POSITION which saves the installation costs encountered in mounting a switch that uses liquid switching elements.	**LIQUID SWITCHING ELEMENTS** which make the switch difficult to mount and very critical to vibration.
IMMUNITY TO VIBRATION you can mount the switch directly on your vibrating or moving equipment.	**ACCORDION DIAPHRAGMS** which make the pressure switch sensitive to vibration.

Ask for bulletin 227

BARKSDALE VALVES

PRESSURE SWITCH DIVISION

5125 Alcoa Avenue, Los Angeles 58, California

are supplied through a sensing unit which will cut off the pilot air supply in the event that the two valve units do not open or close together. This sensing unit is a pressure operated spool valve. One end of this spool valve is internally connected to the outlet chamber of one valve unit; the other spool end is connected to the outlet chamber of the other valve unit. Even at an operating rate of 300 cpm, failure or sluggish opening or closing of either half of the main valve will result in a pressure unbalance on the ends of the spool. This will cause the sensing spool to shift, cut off further pilot air supply, and mechanically lock out. Removal of pilot air pressure makes certain that the main dual-valve units cannot thereafter be operated to cause a press-repeat.

All-Pneumatic Devices

All of the previously mentioned press valves are electrically actuated control elements. Because of the possibilities of electrical and mechanical malfunctions in conventional type relay circuits, a great deal of development work is underway on what is broadly called *logic function* control. At the same time, and for the same general reasons, much interest has recently been shown in a different approach to safer press control, namely, all-air control circuits. These circuits have been developed to include such features as two-hand or two-station control, emergency stop, topstroke stop, continuous cycling, inching or jogging, single stroking, and guard device interlocking.

Two valves that can be used in all-air control circuits have special safety characteristics. The first to be described is part of an air circuit for controlling the starting of a press cycle. This valve, shown in *Fig.* 5, is used when it is necessary—for safety—to make sure that the press operator uses both hands nearly simultaneously to initiate each press cycle. Because of its function, this valve is called a nontie-down valve. It can be seen from the diagram, *Fig.* 5, that the right and left hand halves of the valve are identical. Each half has its own inlet, and the single outlet, or receiver connection, is in the exact middle of the valve. A 3-way normally closed palm button pilot valve is used to supply each inlet. If the flow through the nontie-down valve from each pilot valve is not balanced, one of its valve pistons will shift, and so vent any outlet pressure to exhaust. This makes certain that the press

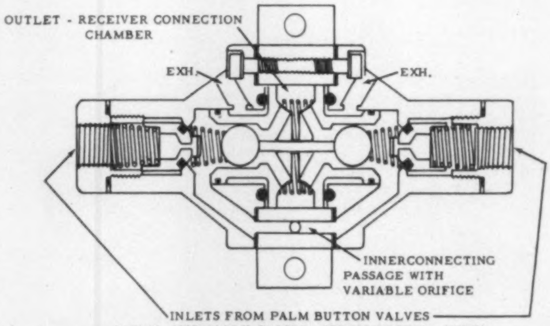

OUTLET - RECEIVER CONNECTION CHAMBER
EXH.
EXH.
INNERCONNECTING PASSAGE WITH VARIABLE ORIFICE
INLETS FROM PALM BUTTON VALVES (3 WAY, NORMALLY CLOSED, SPRING RETURN, TYPE)

Fig. 5—Nontie-down pneumatic valve requires simultaneous operation of two palm button valves to initiate press cycle.

Circle 724 on Page 17

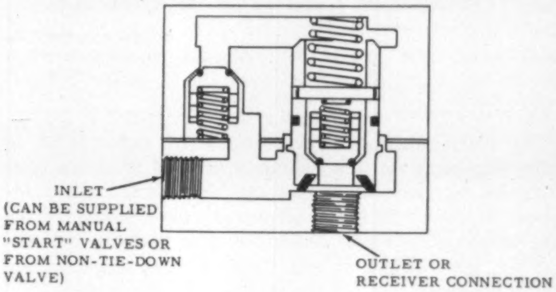


Fig. 6—Single-stroke safety valve is placed in air line downstream of manual-start valve. Initiation of successive press cycles can only occur after single-stroke unit is reset by exhausting its inlet pressure back through manual-start valve after each cycle.

operator uses both hands simultaneously to initiate a press cycle. If the operator engages only one of the hand valves, the nontie-down valve will automatically prevent downstream pressure buildup until the hand valve is released and both hand valves are tripped in unison. A short time delay precedes this action. Release of either one of the hand valves will cause the nontie-down valve to dump any downstream pressure. The nontie-down valve has built-in fail-safe features.

A second type of safety valve can be used downstream of the press-starting air circuit element. It is shown in *Fig.* 6, and is called a single-stroke valve. This valve can be used on the outlet side of a nontie-down valve, or it can be supplied directly from one or more 3-way normally closed press-starting pilot valves. The single-stroke valve first allows a receiver or clutch valve pilot line to be pressurized, and then automatically closes. It remains closed until the manual start valve or valves are released. Safetywise, the valve can therefore be used to force the machine operator to maintain the manual start valves open until a cam operated topstroke stop valve is opened by rotation of the press shaft. Initiation of a succeeding press cycle can only be accomplished after the single-stroke unit has been reset by exhausting its inlet pressure back through the 3-way manual start valves.

The recently published Canadian Standards Association Code, X-142, entitled "Guarding of Punch Presses at Point of Operation," is recommended reading for anyone interested in press safety. This code establishes safeguarding requirements dependent upon the method of feeding the press, the press operating speed in strokes per minute and the type of clutch used. Several all-air press control circuits have been developed to meet these code requirements.

As this discussion has pointed out, there are many different ways to arrange valving for safe operation of a press clutch or brake. Depending on the specific application, certain ways may be less hazardous than others. For best safety, other items, such as adequate guarding and interlocking, are very important and must also be given careful consideration.

From a paper entitled "Clutch-Brake Control Valving," presented at the 45th National Safety Congress and Exposition, Chicago, Oct. 1957.

new HAGEN timer permits setting "on" time directly as PERCENT OF CYCLE

MODEL 75
Percent-O-Cycle
TIMER

SAVES SPACE, CUTS POWER LOSS

Only 3-1/2" square at the face, 4-5/16" deep, the Hagen Percent-O-Cycle Timer is a worthwhile substitute for power-wasting rheostats and variable voltage equipment on many applications. Snap action contacts, operated by synchronous motor drive, permit this unit to handle loads up to 25 amps at 125 volts, 60 cycles. Current input into electrically heated furnaces, etc., may thus be efficiently controlled by turning current on for whatever percent of the time cycle is required.

REPEAT ACCURACY 1/10 OF 1%

Easy to read dial makes it possible to set timer to 1/4% of desired setting. "ON" time adjustable from 1-1/2% to 98-1/2% of total time cycle. Standard time cycles: 15, 30 and 60 seconds; 4, 15, 30, and 60 minutes; 2, 4, and 8 hours.

WIDE FIELD OF APPLICATIONS

Stokers, Pumps, Blowers, Lubrication Systems, Dryers and Dehumidifiers are some of the other uses suggested by the Percent-O-Cycle Timer.

Send for new HAGEN Bulletin 1360.

Write Hagen Mfg. Co., Inc. Moline, Illinois, Dept. A-358.

We are qualified to offer
MACHINING, FABRICATING & ASSEMBLY *facilities for your special or production requirements.*

If you wish to place machine work—anything from an individual machine part to a complete machine—we solicit your inquiries. There's no obligation for the help or estimates, of course, and your inquiries will be handled promptly.

MEDAL MFG. CO.
330 VINE ST., SHARON, PA.

Circle 730 on Page 17

SAVE 3 WAYS with METZGAR "FLOOR -TO- FLOOR" CONVEYOR

SAVES UP TO 9/10 THE COST OF AN ELEVATOR

STAIRWELL INSTALLATION SAVES SPACE

Most stairwells will accommodate standard width conveyors with room remaining for pedestrian traffic.
(O. A. Widths: 18"; 22"; 30").

SAVES ON MAINTENANCE AND OPERATING

Exclusive "Pull Power" with drive pulley at top of conveyor requires less power and provides most efficient belt tracking.

CONSTANT FLOW SAVES PRODUCTION TIME

No freight elevator bottle-neck. No unproductive waiting. Material maintains schedule.

• FREE ASSISTANCE IN PLANNING •

METZGAR CONVEYOR CO.
408 Douglas St. N. W.
MFRS. OF WHEEL & ROLLER GRAVITY & LIVE ROLLER CONVEYORS • POWER BELT CONVEYORS • SWITCHES • ACCESSORIES
GRAND RAPIDS 4, MICH.

Circle 731 on Page 17

AUTOMATION AND OUR ECONOMY

By JOHN T. RETTALIATA,
Pres., Illinois Institute of Technology,
Chicago, Ill.

AUTOMATION has been called progress in action. The distinguishing characteristic of automation is the emphasis on a continuous flow of work as contrasted to stop-and-go methods that retard the progress of even the most advanced conventional forms of mass production. Machines pass parts to one another, give orders to one another, and inspect their own product.

To some, the process is a new industrial revolution; to others, it represents evolution, an extension of mechanization. Whatever the viewpoint, it must be apparent to all that automation will be employed to an increasing extent in the years ahead.

All signs point to a future economy of almost limitless proportions. The nation's population is expected to double to well in excess of 300 million persons in the next 50 years; the gross national product, it is predicted, will double to more than $800 billion in the next 25 years.

Obviously, conventional methods of operation cannot be relied upon to attain the kind of economy being prophesied. Its realization will require utilization of, and further advances in, all of the techniques of automation, controls, electronic computers, motion study, materials handling and others, in addition to some yet to be devised.

In the plant automation starts with the facilities for processing, handling, and control, all integrated to produce the desired results. The key element is proper integration—the organization of the operation into a complete whole. The full potentialities of automation cannot be reached if we think only in terms of the individual machine, or even several machines. The entire process of manufacture from raw material to consumer, must be geared to automation.

Automatic production differs from manual efforts in many ways. It relieves the men and women on the assembly lines of most of the heavy work that is present in many operations, enabling them to devote their entire attention to the more vital aspects of the operation.

There is another important difference between the two methods. That is, machines cannot be laid off if sales slip. The huge investment in an automated production line requires that all phases of the business—raw material procurement, manufacture, warehousing, sales, and distribution—be scheduled for the most effective and economic use of the production facility. In a sense the entire company must be automated.

This goal can be attained only through top management understanding and program co-ordination. New management problems are introduced. Plant communications take on much greater importance; proper employee education and training are vital; increased emphasis on long-range planning becomes necessary; cost elements and job descriptions must be revised.

These are functions which cannot be delegated to a machine. They call into play another factor—the human mind. Quality control, like other developments in industrial progress, must originate in the minds of men. The devices they create and apply are merely new steps in the long train of human effort, which began with the invention of the wheel, and which substitute other forms of power for human muscle.

Science and Engineering

This emphasizes the importance of the quality of the product of institutions such as I represent—well-educated men and women who will be capable of conceiving and developing the tools industry will need to produce the things necessary for the satisfaction of the public's ever-increasing demand for better living. In particular, it will be the scientist and engineer to whom we shall have to look to accomplish this.

Since scientists and engineers will exert a major influence in the development of the greatly expanded industrial economy of tomorrow, which will affect the lives of generations yet unborn, they must be prepared to accept corresponding responsibilities.

There have been changes not only in our processes and products, but in our organizational structures, in growing corporate complexity, in methods of financing and selling, in the relations of business with labor and government, in concepts of business ethics, and in the laws under which business and industry operate. The changes will affect everything the engineer does. Upon him, in increasing measure, business and industry will place greater reliance. He will move more and more into the broader spheres of management as a whole.

There are other calls upon the American engineer. One is the responsibility of conserving our natural resources. In America we rejoice at our good fortune. Our abundance is great compared with that of other nations. We enjoy a standard of living never attained heretofore, and we can look forward to ever-higher levels in the future. But we are paying an enormous price for it. And we are paying for it in terms of a commodity much more valuable than dollars. We are paying for it through expenditure of our natural resources which the voracious appetite of an expanding economy is depleting at a rapid rate.

We have been living in a period of raw material luxury. We now face ever-increasing periods of poverty of natural resources. Conservation, substitution, and replacement must be the necessary and essential ingredients of our future economy. We must cope with the doubly-difficult assignment of achieving a greatly augmented economy at the same time that the resources required for such an economy are diminishing.

Automation, despite its proved performance and tremendous progress in recent years, is in its infancy. Anything which relieves man of drudgery, while giving him better quality products at the same or lower cost, is fundamentally good. Its use will expand as its benefits become more widely known.

From a talk entitled, "Quality in an Automated Economy" presented at the Midwest Conference on Quality Control, Chicago, Oct. 1957.

MAGNATROL VALVE CORP

Eliminate
Costly Flow Failures

Magnatrol
SOLENOID VALVES

Quick Operating *Non Sticking* *Tight Seating*

These three design advantages are your assurance against costly flow failures. Attain dependable, accurate, automatic or remote control of liquids or gases with **Magnatrol Valves.** Installed quickly and easily in connection with . . . flow-meters, thermostats, float and time switches. **Every Magnatrol Valve** is delivered to you—factory **tested—guaranteed free** from defects in material and workmanship.

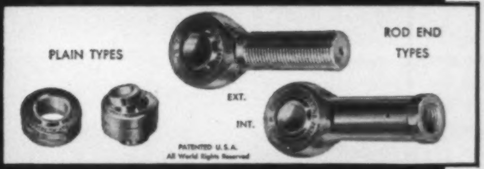
Available in normally closed or normally open models. Pressure ranges from zero up to 300 PSI. Voltages to 575.

Catalog containing complete specifications mailed upon request.

Magnatrol **Valve Corp.**
Hawthorne 22,
New Jersey

Circle 728 on Page 17

"MONOBALL"®
Self-Aligning Bearings



CHARACTERISTICS

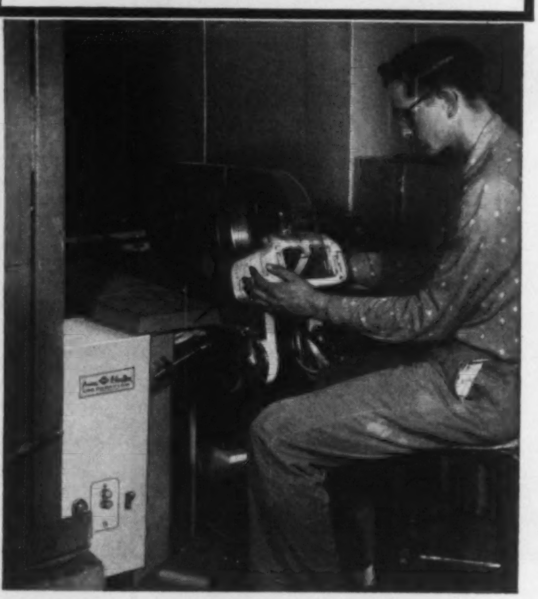
	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for revised Engineering Manual describing complete line. Dept. AUT 58.

SOUTHWEST PRODUCTS CO.
1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA

Circle 729 on Page 17

REV-O-TROL
FULL RANGE SPEED CONTROL
TAPE WRAPS COILS
FASTER-BETTER



PAYS FOR ITSELF IN MORE PRODUCTION ELIMINATION of REJECTS

Complete full range speed control adds to the performance of any machine. Operator selects the exact speed to which his ability, the job involved and the machine are at peak co-ordination. Result: faster production, better, more uniform quality, elimination of rejects.

Rev-O-Trol connects to any 230 volt alternating current source of supply and provides for direct current motor drive. 100% torque available as may be needed by load. Dynamic braking. Hand or foot operated. Reversing control available.

Write for Bulletin R-313.

ACME ELECTRIC CORPORATION
103 WATER STREET • CUBA, NEW YORK
MANUFACTURERS OF
REV-O-TROL

AUTOMATION

new books

PRINCIPLES OF ELECTRICAL MEASUREMENTS

By H. Buckingham, head, Electrical Engineering Dept., Loughborough College of Technology, and E. M. Price, senior lecturer in electrical engineering, Bradford Technical College; 600 pages, 5½ by 8½ inches, clothbound; published by Philosophical Library Inc., New York; available from AUTOMATION; *$15.00 postpaid.*

The British authors of this book discuss instruments for electrical measurement on the basis of principles involved. Deflectional instruments and methods, potentiometer, bridge, thermionic valve, and resonance methods, as well as magnetic measurements and measurement of nonelectrical quantities such as position, pressure and temperature are covered.

MATERIALS HANDLING HANDBOOK

Edited by Harold A. Bolz, associate dean, College of Engineering, Ohio State University, and George E. Hagemann, consulting engineer; 1750 pages, 6 by 9 inches, illustrated, flexible binding, published by Ronald Press Co., New York; available from AUTOMATION; *$20.00 postpaid.*

Comprehensive volume covers types of material handling equipment, related equipment, and considerations in their application. Material presented represents the work of a board of 84 contributing and consulting editors with the advice and counsel of the Joint Materials Handling Handbook Committee of the American Society of Mechanical Engineers and the American Material Handling Society. Assistance was also given by the Technical Committee of the Conveyor Equipment Manufacturers Association.

Association Publications

PROCEEDINGS—1957 NATIONAL CONFERENCE ON INSTRUMENTAL METHODS OF ANALYSIS

Paperbound, 190 pages, 8½ by 11 inches; available from Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.; $7.50.

Publication records papers presented at a conference of the Instrument Society of America. Methods of analysis discussed include optical, x-ray, galvanic cell, nuclear magnetic resonance, ultraviolet, and infrared means. Different aspects of the control of pH are examined in several of the papers.

HANDBOOK OF POWERED INDUSTRIAL TRUCKS

Loose-leaf, 92 pages, 8½ by 11 inches, illustrated; available from Industrial Truck Association, Ninth and F Sts., Washington 4, D. C.; $5.00.

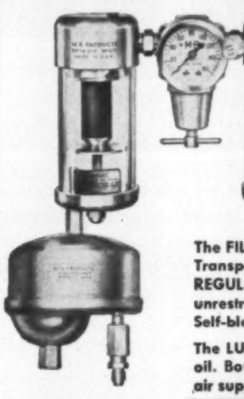
Volume was prepared by Association committees. It discusses planning for and selection of industrial trucks, industrial truck engineering data and cost savings which may be obtained with industrial trucks.

Circle 721 on Page 17

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

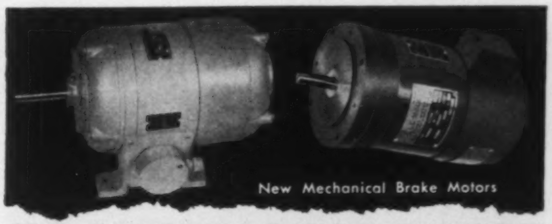
The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The **REGULATOR** can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The **LUBRICATOR** delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M-B PRODUCTS
46 VICTOR AVE., Div. 17
DETROIT 3, MICHIGAN

Circle 732 on Page 17


New Mechanical Brake Motors

CLE-MATIC BRAKE MOTOR

A combination of adjustable, mechanical, braking features, coupled with variations in motor design, enables us to solve your motor problems without special and costly motor controls.

The above CLE-MATIC BRAKE MOTORS are now available in Squirrel Cage design, frame 56 through 225. Ratings: — through 3 HP, 1800 RPM continuous duty and through 5 HP 1800 RPM intermittent duty. Built in 900, 1200 and 1800 RPM's.

Now being used successfully on Bridge, Trolleys, Conveyors and Automation.

OTHER PRODUCTS

We build Squirrel Cage and Slip Ring motors in various sizes. Special designs for special applications.

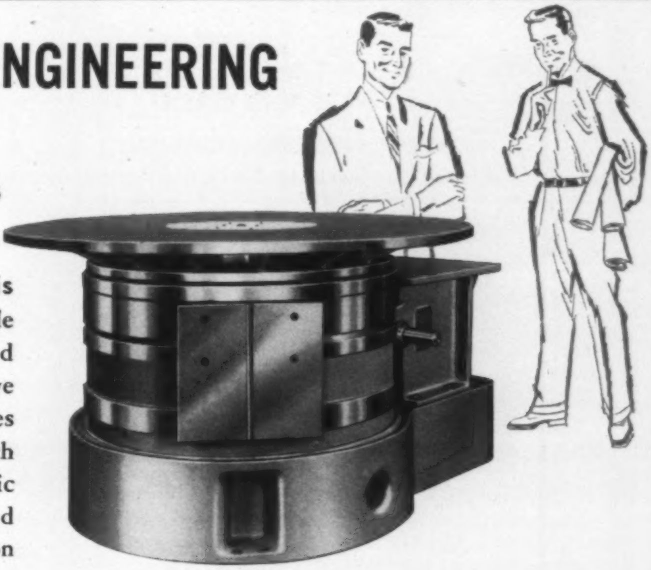
Write for data and prices.

THE
CLEVELAND
ELECTRIC MOTOR COMPANY
5213 CHESTER AVENUE • CLEVELAND 3, OHIO

Circle 733 on Page 17

Save TIME • MONEY • ENGINEERING

on your Special Purpose Machines



Swanson Standard Indexing Chassis make it easier for you to automate a wide variety of manufacturing, processing and assembly operation. No longer do you have to design and build your special machines "from the ground up". When you start with a Swanson chassis, you get your automatic equipment started sooner . . . completed earlier . . . at lower cost. Swanson units have a place in your equipment specifications. Talk with your machine designers.

Write for illustrated folder.

SWANSON-ERIE
CORPORATION
SINCE SEC 1919

814 EAST EIGHTH STREET • ERIE, PENNSYLVANIA
AUTOMATIC ASSEMBLING AND PROCESSING MACHINES

Circle 720 on Page 17

SCHWEITZER Automatic Spray Machine

...for low cost painting of small parts — up to 6000 per hour.

■ Called the "chain-on-edge, automatic spray machine", parts are routed through the booth on revolving spindles attached to a variable speed roller chain. Easily adapted to automatic or semi-automatic loading and unloading, the chain can be used to convey parts from other manufacturing operations, through the oven, and then to shipping.

IMPORTANT FEATURES

- Variable speed conveyor.
- Independently rotated parts spindles.
- Auto or semi-automatic loading & unloading.
- Flexible chain plan form to suit space conditions.
- Syncronized Spraying heads.
- Built-in drying ovens available.
- Choice of dry or water wash booths.

If you need high volume, low cost spraying equipment for small parts, investigate this SCHWEITZER development.
Send for full details,

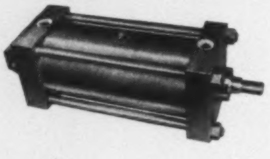
Schweitzer Equipment SECO Company

3704 RIDGE ROAD • CLEVELAND 9, OHIO

Circle 738 on Page 17

Modernair HEAVY DUTY CYLINDERS

for Air or Hydraulic Service



Developed to meet the need for a rugged, reliable cylinder, for heavy mill-type service, MODERNAIR's new Heavy Duty Series are made in two types:

HA • for air service to 200 psi.

HH • for hydraulic service to 1,000 psi.

Both types are available in 3¼", 4", 5", 6" bore sizes, optional stroke length.

Features include:

- ★ Rolled steel heads
- ★ Extra-heavy tie rods
- ★ Heat-treated, chrome plated piston rods
- ★ Self-adjusting "Uneepac" rod seals
- ★ Needle valve cushion adjustment

Write for catalog, prices today—or phone your local MODERNAIR distributor (listed on your phone book Yellow Pages).

Modernair CORPORATION
Trademark
Dept.C3, 400 PREDA STREET, SAN LEANDRO, CALIF.
Member National Fluid Power Association 31

Circle 739 on Page 17

AUTOMATION patents

Copies of patents are available at 25 cents each from the Commissioner of Patents, Washington 25, D.C.

MEANS FOR AND METHOD OF MAKING ELASTIC CUSHION ARTICLES

Latex foam is poured into a trough formed by vertical mold pan and hinged closure. Mold is progressively closed as foam level rises eliminating objectionable voids in finished article. Patent 2,804,650 by Joseph W. Kunce, assigned to United States Rubber Co.

PERCENTAGE TIMING DEVICE

Percentage timer for use in an electric circuit controls the proportionate time of circuit "on" and circuit "off" conditions during an operating cycle. Patent 2,805,293 by Robert L. Daugherty, assigned to Hankscraft Co.

MATERIAL INSERTING MACHINE

Machine folds and inserts individual lengths of fibrous material into a continuously moving series of bottles. Patent 2,805,531 by George H. Dimond, assigned to Consolidated Packaging Machinery Corp.

SAFETY MECHANISM FOR MOLDING APPARATUS

Carriage moves across surface of mold. Pivoted arm mounted on carriage and connected to switch stops machine if charge is not in mold. Patent 2,807,049 by John J. Kimbro, assigned to Radio Corp. of America.

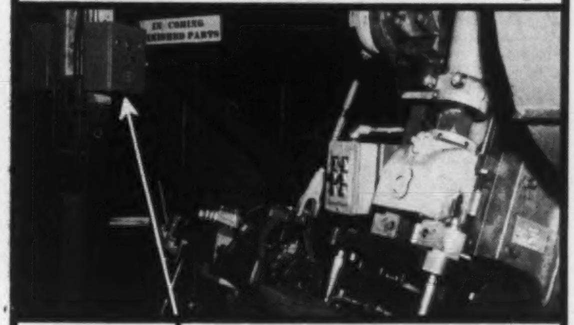
ARTICLE TRANSFER DEVICES

Bottles traveling on a conveyor are picked up by transfer device, rotated in a circular path over a crate traveling on another conveyor, and are released into compartments of the crate. Patent 2,807,125 by Frank Gerald George, assigned to Express Dairy Co. Ltd., London, England.

COIL HANDLING APPARATUS

Apparatus is used to transfer coils from a hook carrier to an assembling table located below and to one side of the carrier. Patent 2,813, 643 by Alfred F. Prentice, assigned to Morgan Construction Co.

Protect Automatic Machinery



Sperry monitron's sensitive control protects this high-speed punch press making appliance parts

Not a chance of damage from pile-ups, misfeeds, dull tools, oversize stock, or faulty lubrication. Monitron stops the machine instantly—*before* damage can be done.

Monitron protection can be easily installed on electrically driven presses, conveyors, pumps, automatic machine tools, etc. It gives your machine every attention, yet needs no attention itself. Install Monitron and let it save man-hours, increase your production!

For complete information, just attach this advertisement to your company's letterhead, give your name and title, and mail to:

SPERRY PRODUCTS, INC.
1203 Shelter Rock Road, Danbury, Conn.

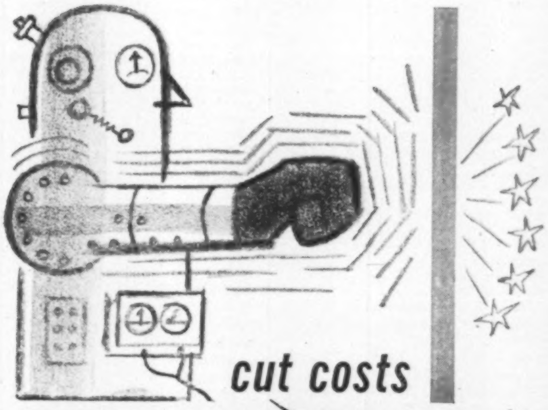
Circle 734 on Page 17

INCREASE PRODUCTION AND REDUCE LABOR COSTS *with* COOK & CHICK PART FEEDERS

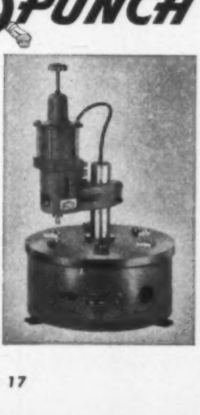
We invite you to investigate our complete line of part feeders and escapements suitable for selecting and feeding parts automatically to machining and assembly operations. Tell us your job requirements and we will recommend the most suitable equipment.

COOK & CHICK CO. *Established 1879*
2415 W. 24th St. Chicago 8, Ill.

Circle 737 on Page 17



cut costs with ELECTRO PUNCH



This high-production tool delivers controllable impacts — from light tapping to 3500 lb.* blows. It's shown here mounted on the Electrotable — B&W's fast, accurate indexing unit. Free booklet tells you how to speed up riveting, staking, marking, etc. Write for it *today.*

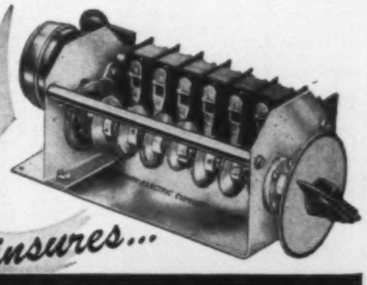
*Other models to 10,000 lbs.

BLACK & WEBSTER, INC.

Dept. 2, 445 Watertown Street,
Newton 58, Mass.

Solenoid Operated Production Tools

Circle 735 on Page 17



ZENITH Multi-Circuit CYCLE TIMER *insures...*

long-lasting accuracy . . . trouble-free performance in timing, mixing, compounding, processing and similar operations!

Sound, practical design, quality components and precision-controlled assembly insure the long-lasting dependability of ZENITH Multi-Circuit Timers. They are specified as standard components in countless commercial and industrial applications, as well as laboratory equipment and home appliances.

Can be supplied in practically any time cycle and with any number of switches. Available without synchronous motor for elevator control, limit switch, etc.

IMMEDIATE DELIVERY IN ANY QUANTITY . . .
Request bulletin.

See classified telephone directory for name of local distributor

ZENITH ELECTRIC CO.

145 W. WALTON ST. • CHICAGO 10, ILL.

Circle 736 on Page 17

CUMULATIVE EDITORIAL INDEX

Including six issues. Number preceding the hyphen is month of issue; those following are page numbers in that issue.

A

Accounting, industrial cost, 11-38
Actuation, transfer machine, 11-49
Actuators, hydraulic, 3-86
Air blending, 3-14
Amplifiers, transmission circuits, 2-84
Analog to digital converter, 11-26
Analysis, instrumental methods, 3-156
Antalis, S. J.
  Control Transformer Designed for Automatic Production, 10-73
Application,
  proximity transducers, 2-69
  transistor circuits, 2-84
Assembly, 12-60
  automated, 11-47; 12-66; 1-52; 3-9
  automobile, 12-31
  electrical, 12-66
  electronic components, 10-82; 3-58
  pistons & rings, 10-23
  press fit, 11-47
  principles, 1-58
  problem, gas cartridges, 12-136
  rear axle shafts, 11-47
  roller bearings, 2-57
  skate wheels, 10-42
  small motors, 3-9
Automation,
  accounting system for, 11-38
  and government, 11-150
  and labor, 11-150; 2-19, 52; 3-12
  and paperwork, 3-65
  and process control, 12-40
  and small business, 11-150
  and supplemental unemployment benefits, 2-52
  and the economy, 10-157; 3-154
  and the public, 11-150
  degrees of, 12-139
  drilling machine evolution, 10-62
  economics, 11-38
  for small-lot producers, 3-54
  in automobile industry, 10-31; 11-31
  in banks, 12-9
  in national economy, 11-150
  intersociety organization, 12-34
  in railroads, 2-12
  national implications, 11-9
  organizing for equipment developing, 10-151
  philosophy, 10-157; 11-31; 12-61; 1-141; 3-154
  planning for, 10-73; 12-61; 1-37; 3-54
  social effects, 11-150
Automobile,
  bodies, 12-31; 3-93
  crankshaft balancing, 2-80
  seats, 3-93

B

Bakery operations, 10-49; 2-91
Banking between operations, 1-59
Banks, automation in, 12-9
Batching systems, 10-69
Bearings,
  manufacture, 10-9, 12; 2-57
  needle assembly, 12-60
Bill changer, 2-12
Blending control, 12-57; 3-94
Blending dry materials, 3-14
Bolz, R. W.
  The Right Perspective, edit., 3-53
Braiding wire, 12-46
Bulk handling, 10-49; 11-73; 12-69; 3-16, 94
Buying, special equipment, 11-31

C

Carrier current switching, 10-14
Centralized control, 12-40
Charging thermostatic units, problem, 1-138
Classification automation systems, 12-139
Close, G. C.
  Computer Control Closes the Loop, 12-57
Cocks, E. H.
  Automatic Spray Painting of Electrical Conduit, 3-69
Communication type controls, 3-82
Computers,
  analog, 3-20
  digital programming, 12-12, 57
  for airlines, 1-14
  for design, 12-10
  for flood control, 2-12
  for inventory control, 3-10
  for process control, 12-21, 57
  transistorized, 12-12
Concrete batching, 10-69
Conduit painting, 3-69
Constant speed motors, 1-85
Controls,
  automatic balancing, 2-80
  batching system, 10-69
  beer filling, 10-84
  by ultrasonic test equipment, 10-82
  calendering rolls, 10-80
  continuous process, 1-14
  design to be foolproof, 3-43
  electrical power supply, 10-12; 1-14
  electronic, 2-150
  electropneumatic, 11-64; 3-33, 78
  feed roll, 11-162
  flour weighing, 11-62
  flow, 10-84
  gaging, 11-76; 3-73
  glass melting, 3-16
  handling system, 11-57
  heat-treating, 11-59
  honing, 11-20
  machine tools, 3-27
  machines, 12-50
  mechanical-pneumatic, 11-64; 3-78
  nail feeder, 3-89
  numerical, 11-9; 12-50; 2-9, 16
  of material level, 1-78
  of motor speed, 1-85
  of presses, 3-146
  panels, 12-40; 3-10
  plug-in, 3-82
  pneumatic handling, 10-49
  power plant, 12-12
  precipitation, 10-16
  proximity transducers, 2-69
  pumping, 10-84
  punched card, 11-23
  solid-liquid proportioning, 10-60
  soot blowers, 12-71
  static, 3-75
  stepping switch, 3-89
  thickness, 10-80
  transfer machine, 11-49
  transformers, 10-73
  transistors in, 2-84
  weighing, 10-69
Conveyors,
  bulk material, 2-10
  food industry, 10-82; 2-91, 93
  overhead, 10-35; 12-73; 1-63
  pneumatic for flour, 11-62
  pneumatic for grain, 11-73
  pneumatic for solids, 12-69
  roller bearings, 2-57
  sensing material on, 69
  solid-liquid proportioning, 10-60
  storage, 10-35
  storage problem solutions, 12-136
  systems, 11-73; 12-72; 1-10, 63
Coolant filtering, 11-72
Cost analysis,
  for automation, 11-38
Counting devices, 2-25
Crankshafts, 10-31; 2-80
Crystals, memory devices, 12-16
Cutoff, tubing, 3-60

D

Data processing, 10-69; 11-10, 19; 12-21, 40; 1-10, 152; 2-14; 3-10, 16, 65
Data recording, 2-72
Data storage, 2-10; 3-24
Data transmission 12-40; 2-14, 23
Design,
  for automated production, 10-73; 12-142; 3-58
  for foolproof automation, 3-43
  of continuous production machines, 10-151; 12-61
  of controls for reliability, 2-150
  of electronic equipment for reliability, 10-164
  of magnetic amplifiers, 10-164
  of saturable reactors, 10-164
  of printed wire boards, 10-16
Detectors,
  tramp metal problem, 2-148
Development of equipment, 10-151
Diecasting, 10-35
Digital recording, 2-72
Direct magnetic recording, 2-72
Drilling, 10-62; 12-50; 3-22
  crankshaft balancing, 2-80
Drills, spiral point, 11-9
Dynamic balancing, 2-80

E

Economics, 12-10
Ejecting assemblies, 1-52
Elan, D.
  Applying Proximity Transducers, 2-69
Electrical,
  cable 12-66
  component mounting, 11-56
  machine control, 11-49; 2-69
Electromagnets, 1-43
Electronics, 11-164
  assembly, 10-82; 2-16; 3-58
  bill changer, 2-12
  component packages, 1-14
  data processing, 2-161
  improving reliability of, 2-150
  laboratory devices, 2-19
  transistor application, 2-84
Elevator,
  for parts, 1-52
  interfloor, 11-57
Engineering,
  scientific background, 1-37
Engines, gas turbine, 10-31
Escapements, 10-42; 1-52; 2-94
Evaluation, pumps and actuators, 10-54
Extractor, vacuum, 1-154
Extrusion, titanium, 1-12

F

Fabric finishing, 12-72
Failsafe controls, 3-43
Fasteners, 11-164
Feedback, 12-40
Feeders,
  bar, 1-88
  blank, 1-154
  control, 3-89
  for fasteners, 11-12
  for small parts, 1-52; 2-25
  pneumatically controlled, 3-94
  selectors, 12-148
  stamping press, 2-10
  transducer controlled, 2-69
Feeding,
  assembly components, 10-42; 1-52
  electrodes, 2-94
  metal sheets, 11-71
  plastic components, 11-162
  thin materials problem, 11-34
Filtering,
  coolant, 11-72
  slurry, 2-92
Fittings, nylon compression, 2-28
Fixtures, for assembly operations, 1-56
Floats, 1-59
Flow control, 12-12, 22
Food processing, 11-62, 73; 2-91
Forging crankshafts, 1-75
Forming,
  sheet material, 3-93
  strip material, 11-162
Frequency modulated carrier recording, 2-72
Functional testing, 3-61
Furnace control, 11-10
Furniture making problem, 10-148

G

Gaging,
  combined in-process and post-process, 3-73
  components problem, 10-148
  dynamic balancing, 2-80
  in control, 12-139
  in-process, 11-20, 76
  liquid height, 1-16, 78
  on machine tools, 11-76; 1-19
  post-process, 1-81
  radiation, 10-80
Garment, packaging problem, 10-148; 3-51
Gas turbines, 10-31
Glass grinding & polishing, 11-43
Grinding,
  and polishing, 11-43
  control, 11-76; 3-73
  crankshafts, 10-31
Gruber, W. M.
  In-Line Production Balancing, 2-80

H

Hadekel, R.
  Hydraulic Control of Automatic Machinery, 10-54; 12-74; 2-63
Handling, 3-159
  back-to-back hobbing, 10-12
  bakery operations, 10-49; 2-91
  banking, 1-59
  billets, 1-75
  bulk materials, 10-49; 11-62; 12-69; 2-10; 3-16, 94
  cans, 12-14
  cases, 11-162; 3-92
  conveying, 1-63
  crankshafts for balancing, 2-80
  electrical components, 10-162
  flour, 11-62
  for assembly, 1-52
  for forging, 1-75
  for heat treating, 11-59
  garment materials, 11-23
  grain, 11-73
  in transfer machine, 11-49
  interfloor systems, 11-57
  logs, 12-56
  magnetic, 1-43
  pallets, 11-57; 12-14
  piling bulk materials, 3-85
  plate glass, 11-43
  roller bearings, 2-57
  scrap, 12-34
  steel bar, 1-88
  to machine tools, 1-59
  universal motions, 10-10
Heat treating, 11-59; 12-73
Heating,
  radio frequency, 12-148
  titanium forgings, 11-12
Holding, parts for assembly, 1-56
Honing control, 11-20
Hydraulics,
  actuators, 10-54; 3-86
  control, 2-63
  cylinders, 10-54
  drive system, 11-162
  machine system, 11-47, 49
  motors, 10-54
  press system, 3-75
  pumps, 10-54
  valves, 12-74

I

Indexing,
  assembly machines, 11-47
  devices, 3-86
  in transfer machine, 11-49
Information handling, 12-40; 2-72, 161; 3-65
Infrared camera, 11-12
Ingredient mixing, 10-60
In-process gaging, 11-76
Inspection,
  automatic, 12-139; 1-59
  crankshaft balance, 2-80
  in transfer machine, 11-49
  testing, 3-61
  ultrasonic equipment, 10-83
Insulating wire, 12-46
Integrated handling, 1-42
Integrating automatic operations, 1-59
Isotopes in production operations, 1-78
Israelson, A. F.
  Magnetic Handling Devices, 1-43

L

Lathes,
  loading problem, 1-138
  numerical control, 12-50
Lemelson, J. H.
  Guideposts to Automation Planning, 2-52
Level control problems, 10-148
Linear programming, 10-164
Liquid filling, 10-84

Load cells, 10-60; 3-94
Loading, 12-14, 56; 3-92
Lubrication,
  printing press, 12-73

M

Machine tools, 11-9
  contour roll lathe, 11-23
  control, 1-81; 3-73, 82
  developing for automation, 10-9
  die clamps, 10-14
  drilling, 10-62
  gaging for, 11-76
  grinding, 10-31
  hot feeder, 10-12
  in crankshaft balancing, 2-80
  tape controlled, 10-66
  transfer, 11-49; 12-142
  turning, 10-31
Machines,
  assembly, 10-151; 11-47; 2-57
  boring, 2-9
  circuit board, problem, 3-51
  cutoff, 3-60
  development of, 12-61
  drilling, 3-92, 93
  duct winding, 12-12
  dynamic balancing, 2-80
  electrical testing, 10-151
  extrusion press, 2-19
  fabric finishing, 12-72
  inspection, 10-151
  inspection problem, 11-34
  leather processing, 11-14
  numerical control, 12-50; 2-9
  nut tapping, 12-148
  paging, 12-148
  painting, 12-19
  pneumatic, 11-64; 3-78
  printing press, 12-73
  surface finishing, 12-148
  tape controlled, 3-57
  testing, 11-26; 3-61
  tire inflating, 12-36
  welding, 12-66
  wire insulating, 12-46
  wire-wrap connection, 11-56
Magnetic,
  amplifiers, 10-164
  equipment applications, 1-43
  handling devices, 1-43
  memory device, 2-10
  tape recorders, 2-72; 3-24
Magnets,
  belt conveyor application, 10-42
  ceramic, 10-12
  permanent, 1-43
Maintenance, 12-150
Manufacture,
  design for, 12-142
Manufacture of,
  aluminum strip, 2-93
  automobile bodies, 12-31; 3-93
  automobile camshafts, 11-49
  automobile crankshafts, 1-75
  automobile engines, 1-63
  automobile frames, 1-63
  automobile parts, 1-88
  automobile seats, 3-93
  cement, 2-92
  control transformers, 10-73
  cores, 1-154
  crankshafts, 10-31
  design for, 12-142
  diecastings, 10-35
  finned wire, 1-154
  freight car wheels, 12-73
  gears, 1-59
  gun shells, 3-9
  ink cartridges, 11-71
  magnetic tape, 10-83, 162
  motors, 3-9
  pipe, 3-92
  plate glass, 11-43
  roller bearings, 10-9; 1-37
  rubber coated fabric, 10-80
  skate wheels, 10-42
  soldering printed circuits, 10-23
  teflon bearings, 10-12
  telephone apparatus, 12-61
  thread rolling dies, 11-59
  veneer, 12-56
  window frames, 1-63
Manufacturing functions in small-lot automation, 3-58
Materials handling, 10-49; 12-69; 1-10, 33; 2-10; 3-16, 24, 156
Maynard, A. F.
  Automation for Small-Lot Producers, 3-54
McCabe, L. E.
  Automation for Small-Lot Producers, 3-54
Measurement, electrical, 3-156
Measuring,
  liquid level, 1-78
  temperatures, 11-14
  thickness of sheets, 12-12
Memory, 11-62; 12-16
  devices, 2-23
  twisted wire, 2-10
Metals, joining technique, 12-14
Metering pumps,
  liquids, 10-162
Milioto, R. P.
  Automation for Small-Lot Producers, 3-54
Miller, L. D.
  Control of a Transfer Machine, 11-49
Milligan, W. E.
  Automatic Weighing and Blending, 3-94
Milling, numerical control, 12-50
Mixing liquids & solids, 10-60
Mohr, P. A.
  Magnetic Tape Systems for Data Recording, 2-72
Moisture control, 10-148
  problem, 11-34; 3-57
Molding plastics, 3-12, 75
Molding wax tires, problem, 1-138
Moritz, J. M.
  Basic Pneumatics for Automation, 11-64; 3-78
Moskowitz, L. R.
  Magnetic Handling Devices, 1-43
Motors,
  drive, 1-85
  hydraulic, 10-54
  reversing problem, 11-34

N

Nail feeding, 3-89
Needle bearing assembly, 12-60
Neklutin, C. N.
  Automation Economics Requires Engineered Accounting, 11-38
Nuclear reactors, 11-16
Numerical control, 12-50, 61; 1-34; 2-16; 3-27
  boring machine, 2-9

O

Operations research, 11-164
Orienting,
  assembly components, 1-52
  device, 1-154
Ovens,
  fabric finishing, 12-80
  infrared, 2-92
  magnetic tape manufacture, 10-83
  plastic finishing, 3-14

P

Packaging,
  cans, 12-14
  food products, 10-82
  machines, 3-12
Packing, garment, problem, 3-51
Painting, 12-31
  conduit, 3-69
  systems, 12-19
Paulson, C. C.
  Integrated Heat Treating Through Automation, 11-59
Petersen, G. R.
  For Plus Advantages Specify Numerical Control, 12-50
pH control, 1-152
Philosophy,
  automation, 1-9, 141; 2-52
  establishing automated facility, 10-73
  special machines, 11-31
Placing, parts for assembly, 1-52
Planning for automation, 10-73
Plating, wire, 10-67
Pneumatic,
  conveying, 11-73
  conveying problem, 10-148
  handling, 10-49; 12-69
  hole test & blowout, 11-49
  machine systems, 11-64; 3-78, 146
  motion control, 11-64; 3-78
  power units, 11-14
Polishing plate glass, 11-43
Positioning,
  control, 10-162; 12-50
  device, 12-61; 2-148
  in transfer machine, 11-49
  pneumatic, 3-78
Post-process gaging, 1-81
Powder metallurgy, 3-20
Presses,
  automated, 12-50
  control, 11-20; 2-14; 3-75
  extrusion, 2-19
  feed mechanism, 2-10
  transfer, 1-33
  transfer devices, 2-93
Printed circuit plating, 11-71
Printing press equipment, 12-73
Probes, in transfer machine, 11-49
Process,
  concrete batching control, 10-69
  control, 12-40, 57; 2-14
  painting, 12-19
  plastic molding, 3-12
  powder metallurgy, 3-20
Processor, film, 1-12
Programming, 10-164; 12-12; 3-57
  graph scanning, 10-10
  soot blowers, 12-71
Proportioning, 10-49; 3-94
  system, 10-60
Proximity pickups, 2-69
Pulse width modulation recording, 2-72
Pumping control, 10-84
Pumps, 10-54
Punched cards, 10-69; 12-50
  in data processing, 3-65
  weighing control, 11-23
Punched tapes, 12-50; 2-14
Pürdy, C. A.
  Automatic Production of Telephone Apparatus, 12-61
Puricelli, R.
  Drilling Machine Progress High-Lights Evolution Into Automation, 10-62

Q

Quality control, 3-61

R

Radiation gages, 10-80; 1-78
Reader, E. G.
  Handling Small Parts for Assembly, 1-52
  Tooling for Automation Assembly in Skate Wheel Production, 10-42
Recorded data playback, 2-72
Rectifier silicon controlled, 2-25
Regas, S.
  Radiation Gages Improve Bulk Material Level Control, 1-78
Relays,
  control, 3-82
  noise-operated, 1-20
  protective, 2-161
Reliability,
  of electronic controls, 2-150
  of electronic design, 10-164
Roller bearings assembly, 2-57
Rolling mills, 2-93
Rotary,
  stepping switch application, 12-71; 3-89
  switch problem, 10-148; 3-51

S

Safety devices, 2-14; 3-159
Salary study, 12-14
Saturable reactors, 10-164
Sensing systems, 2-69
Servosystem, 1-152
Servo valves, 2-63
Sherman, A.
  Concrete Batcher Actuated By Punched Card Control, 10-69
Sign typewriter, 3-22
Signal conversion, transistor circuits, 2-84
Skate wheel manufacture, 10-42
Skiving teflon, 12-46
Smith, E. W.
  Plug-Ins Provide Versatile Machine Control, 3-82
Soldering, 10-23; 12-148
Sorting, gaged parts, 1-81; 3-73
Souler, R. A.
  Dimensional Controlling Systems, 11-76; 1-81; 3-73
Special purpose lines, 10-151
Sperry, A. F.
  Process Control Emphasizes Information Handling, 12-40
Spray painting, 3-69
Stamping feed mechanism, 2-10
Stepping switches, 3-89
Stewart, H. L.
  Basic Pneumatics for Automation, 11-64; 3-78
Storage, problem solutions, 12-136
Straighteners, bars, 11-10
Supplemental unemployment benefits, 2-52
Suuronen, E.
  Automation for Small-Lot Producers, 3-54
Switching transistor circuits, 2-84
Symbols, pneumatic, 11-67
Systems,
  analysis, 12-50
  approach to automation, 3-54
  engineering, 10-54
  hydraulic, 12-74; 2-63

T

Tanning leather, 11-14
Tape controlled,
  punching machine, 3-57
  testing machine, 3-63
Telemetering, 1-14; 2-72
Testing, 12-10
  electrical, 12-46; 2-35
  electron tubes, 11-26
  electronic equipment, 3-61
  functional, 3-61
  inspection, 3-61
  mechanical properties, 11-70
  steel wire, 2-14
Timing percentage, 3-159
Tool,
  drilling, 3-22
  strapping, 12-22
  thread top, 3-24
Transducers, 3-14
  air to electric, 3-30
  proximity, 2-69
Transfer devices, 10-10; 12-56; 1-63; 2-93; 3-159
Transfer machines, 10-62; 11-31, 49
  assembly operations, 10-42
Transistors, 12-50; 1-152
  application, 2-84
Translation, technical publications, 3-10
Trucks, industrial, 3-156
Turning, crankshafts, 10-31

U

Ultrasonic equipment, 11-12

V

Valves,
  automatic, 12-74
  control, 12-74; 2-30
  pneumatic, 3-146
  servo, 2-63
Variable speed motors, 1-85
Vibration analyzer, 12-19
Viscosity control, 9-61

W

Walker, J. R.
  Applying Transistors, 2-84
Warehousing, 10-83; 12-72
Washing, fluorescent tubes, 11-70
Webb, J. C.
  Automatically Handling Parts In Process, 1-63
Weber, W. C.
  Hydraulic Actuation Simplified, 3-86
Weighing, 10-60; 11-62; 1-12, 14
  control, 10-69; 3-94
Weight control, 10-162
Welding, 12-50, 66; 1-9
  carbon dioxide process, 10-82
  control of, 2-69
  submerged arc, 12-72
Weller, L. G.
  Pneumatic Handling Systems Solve Problems of Moving Bulk Materials, 12-69
Westeren, H. W.
  Integrated Heat Treating Through Automation, 11-59
Wire,
  assemblies, 12-46, 66
  plating, 10-67
  stripping, 11-19
  wrapped connections, 11-56; 12-61
Worthman, L. H.
  Guideposts to Automation Planning, 2-52

X

X-ray inspection, 12-12

Z

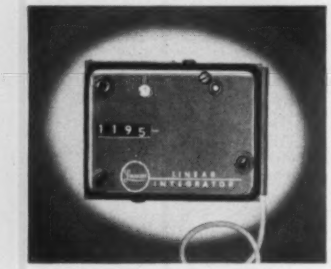
Zawaski, F.
  Auxiliary Handling Devices Integrate Standard Machines, 1-59

New Series of INTEGRATORS

Strip Chart Recorders—for Flow Totalization, Temperature Recording, Averaging.

Type: LIBRASCOPE Model 25 Computing Linear Integrator.

Applications: Fits most standard strip chart recorders for area computations in gas analysis procedures, temperature recording averaging and flow totalization where a direct or remote reading is required. The Integrator is normally mounted in a position to accept the output of the transducer or recorder pen motion as an input.



Features: Model 25 is designed to provide a fast, accurate, reliable and continuously integrated total of data as it is being recorded or presented. Ends inaccuracies of totalizing by eliminating manual integration. It is compact and easy to install. With recommended lubrication, a trouble-free, long life is assured.

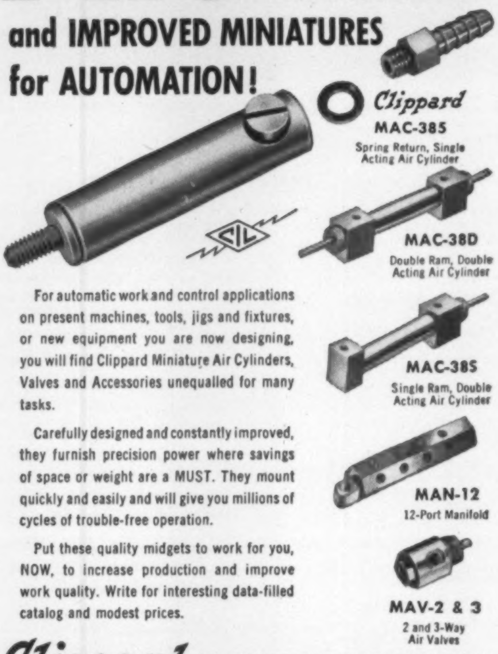
Construction and Operation: Model 25 Integrator can be installed on any device having a shaft rotation or displacement as an output. It is a ball disc integrating mechanism having a counter and an electrical pulse switch for remote reading. Dimensions: 3 in. x 4.38 in.; weight: 1.5 lbs.

Other Librascope Integrating Mechanisms: Ball/Disc Integrator, Flow Computer. For descriptive catalogs, write Librascope, Inc., subsidiary General Precision Equipment Corporation, 810 Western Avenue, Glendale, California.

Circle 740 on Page 17

PROVED

and IMPROVED MINIATURES for AUTOMATION!


Clippard
MAC-385
Spring Return, Single Acting Air Cylinder
MAC-38D
Double Ram, Double Acting Air Cylinder
MAC-38S
Single Ram, Double Acting Air Cylinder
MAN-12
12-Port Manifold
MAV-2 & 3
2 and 3-Way Air Valves

For automatic work and control applications on present machines, tools, jigs and fixtures, or new equipment you are now designing, you will find Clippard Miniature Air Cylinders, Valves and Accessories unequalled for many tasks.

Carefully designed and constantly improved, they furnish precision power where savings of space or weight are a MUST. They mount quickly and easily and will give you millions of cycles of trouble-free operation.

Put these quality midgets to work for you, NOW, to increase production and improve work quality. Write for interesting data-filled catalog and modest prices.

Clippard INSTRUMENT LABORATORY, INC.
7386-A Colerain Rd., Cincinnati 39, Ohio • Phone: JAckson 1-4261
Manufacturers of R. F. Coils, Electronic Equipment, Miniature Pneumatic Devices

Circle 742 on Page 17

are you stuck?

In the past few years AUTOMATION has helped in the solution of hundreds of widely diversified practical problems in making operations more automatic. Regardless of the character of the operation or system being developed, somewhere in industry a similar problem has been solved and, very often, equipment is available or suitable techniques are known.

Development can be simplified, engineering costs reduced, and reliability guaranteed with tried and proved equipment and devices available today for achieving successful automation. Whether the problem is simple or complex, practical or technical, the Editors will be pleased to help find the right answer. The vast reservoir of industrial know-how is yours for the asking. Take advantage of this service. Write to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio.

Advertising Index

Acme Electric Corporation 156
Airmatic Valve, Inc. 151
Allen-Bradley Co. 35, 36
Allied Steel & Conveyors, Division of Sparton Corporation 38, 39
Allis, Louis, Co., The 101
Alvey-Ferguson Co., The 134
American Chain & Cable, Automotive & Aircraft Division 116
American Society of Tool Engineers 112
Automation Devices, Inc., Vibratory Feeder Co. Division 150
Automotive & Aircraft Division, American Chain & Cable 116

Barksdale Valves, Pressure Switch Division .. 152
Bellows Co., The 5
Black & Webster, Inc. 159
Bruno-New York Industries Corporation 34
Buckeye Tools Corporation 127
Buschman, E. W., Co., The 129

Chicago Tramrail Corporation, Floor Covering Equipment Co. Division 11
Cleveland Electric Motor Co., The 157
Cleveland Worm & Gear Co., The, Speed Variator Division 13
Clippard Instrument Laboratory, Inc. 162
Commercial Contracting Corporation 8
Cook & Chick Co. 159
Crown Zellerbach Corporation, Gaylord Container Corporation Division 107

Dexter Folder Co., Division of Miehle-Goss-Dexter, Inc. 40
Dynamatic Division, Eaton Manufacturing Co. 31

Eaton Manufacturing Co., Dynamatic Division 31
Enterprise Machine Parts Corporation, The .. 151
Eriez Manufacturing Co. 97
Exact Weight Scale Co., The 133

Federal Press Co. 145
Federal Products Corporation 28, 29
Ferguson, J. L., Co. 125
Floor Covering Equipment Co., Division Chicago Tramrail Corporation 11
Fuller Co. 105

Garrision Machine Works, Inc. 23
Gaylord Container Corporation, Division of Crown Zellerbach Corporation 107
Gear-O-Mation, A Division of Michigan Tool Co. 103
General Controls 26
General Electric Co. 136, 137, 138, 139
Gray Equipment Co. 131
Greenlee Brothers & Co. 2

Hagen Manufacturing Co., Inc. 153
Handicraft Tools, Inc., Division of X-acto, Inc. 163
Hayes, C. I. 98
Howe Scale Co., The 113

J-I-C Electric Co. 119

Kearney & Trecker 15

Lanham Co., The 143
Lansing Stamping Co. 151
Librascope, Inc. 162
Lipe-Rollway Corporation 27
Littell, F. J., Machine Co. 130
Logan Co. 115
Logansport Machine Co., Inc. 41
Lynch Robo Corporation 42

McGill Manufacturing Co., Inc. 141

M-B Products 157
Magnatrol Valve Corporation 155
Master Electric Co., The, Division of Reliance Electric Engineering Co. .... Inside Back Cover
Mathews Conveyer Co. 30
Matthews, Jas. H., & Co. 147
Mechanical Air Controls, Inc. 32, 33
Medal Manufacturing Co. 154
Metzgar Conveyor Co. 154
Michigan Tool Co., Gear-O-Mation Division .. 103
Miehle-Goss-Dexter, Inc., Dexter Folder Co. 40
Micro Switch, A Division of Minneapolis-Honeywell Regulator Co. 19
Minneapolis-Honeywell Regulator Co., Micro Switch Division 19
Modernair Corporation 158

National Acme Co., The 6, 7, 109

Onsrud Machine Works, Inc. 25

Post Electronics Division of Post Machinery Co. 51
Post Machinery Co., Post Electronics Division .. 51
Pratt & Whitney Co., Inc. 20, 21

Reeves Pulley Co., Division of Reliance Electric & Engineering Co. 22
Reliance Electric & Engineering Co., The Master Electric Co. Division ... Inside Back Cover
Reliance Electric & Engineering Co., Reeves Pulley Co. Division 22
Richards-Wilcox Manufacturing Co. 24
Ross Operating Valve Co. 1
Roto Manufacturing Co. 114

Schrader's, A., Son Division of Scovill Manufacturing Co., Inc. 123
Schweitzer Equipment Co. 158
Scovill Manufacturing Co., Inc., A. Schrader's Son Division 123
Southwest Products Co. 155
Sparton Corporation, Allied Steel & Conveyors Division 38, 39
Sperry Products, Inc. 159
Sperry Rand Corporation, Vickers, Inc., Division 52
Stewart-Glapat Corporation 142
Swanson-Erie Corporation 157

Toledo Scale Co. 37

United States Drill Head Co. 128

Valvair Corporation 121
Vibratory Feeder Co., Division of Automation Devices, Inc. 150
Vickers, Inc., Division of Sperry Rand Corporation 52
Victory Engineering Corporation 135

Watts Regulator Co. .... Back Cover
Wean Equipment Corporation .. Inside Front Cover
Westinghouse Electric Corporation 45, 46, 47, 48, 49, 50, 110, 111, 148, 149
West Instrument Corporation 144
Wiegand, Edwin L., Co. 132

X-acto, Inc., Handicraft Tools, Inc., Division 163

Yoder Co., The 16

Zenith Electric Co. 159

Consulting Engineer's Service 164

Classified Advertising 164

FOR SAFETY'S SAKE

and better work, too...

x-acto®
surgically-sharp
KNIVES

Interchangeable blades for all cutting, slicing, trimming, slitting jobs!

Cutting efficiency and safety with a blade shaped to suit your needs. Try-out order! $1.00 for knife handle and sample blade assortment. Catalog of complete knife and blade line on request.

If you have any special requirements for cutting tools, call us at once.

x-acto INDUSTRIAL CUTTING TOOLS

Handicraft Tools, INC.
A division of X-acto, Inc.
48-41S Van Dam Street
Long Island City 1, N. Y.

Circle 743 on Page 17

WORRY WON'T CURE CANCER

If cancer is detected in its early, localized stage, the chances for cure are very much better. Play it safe and smart. See your doctor for a checkup every year.

And fight cancer with a check!

Mail it to
CANCER, in care
of your local
post office
—NOW

AMERICAN
CANCER
SOCIETY

AUTOMATION

professional services

Let these consultants supply the answers to your engineering and automation needs

E. W. Larrabee, Inc.
—Automation Systems—
Specializing In
Automatic Assembling Equipment
For Small Parts
150-34 12th Avenue Whitestone 57, N. Y.
Hickory 5-2800

Gemar *Associates*
CONSULTING
MATERIALS HANDLING
ENGINEERS
over 25 years experience
GREENWICH, CONNECTICUT

Halm Instrument Co., Inc.
Automation — Special Machinery
Design & Manufacture of Automatic Equipment
Glen Head Road Glen Head, N. Y.
Telephone Glen Cove 4-6700

BARKLEY & DEXTER, INC.
BARKLEY & DEXTER LABORATORIES, INC.
"Engineering For More Economic Production"
Since 1905
Automation—Automatic Machinery
Design And Development—Electronics
Instrumentation—Optics—Industrial Research
50 Frankfort Street Fitchburg, Mass.

Automation Industries, Inc.
AUTOMATION SYSTEMS
Consultants · Research · Design
· Development · Manufacture
Marble Road, Cockeysville, Md.
Tel. Cockeysville 1090

THE TELLER COMPANY
Design and Project Engineering
For Automatic Machines, Processes and Plants
For New Products, Plants, Plant Expansion or
Modernization. Phone, Wire or Write Now—
Call BUtler 7-5739 BUTLER 2, PENNSYLVANIA

KURZWEIL ASSOCIATES, INC.
CONSULTING ENGINEERS
COMPLETE AUTOMATION PROJECTS
ENGINEERED AND DESIGNED FOR
REDUCED MANUFACTURING COSTS
7 E. 47th St. • New York 17, N.Y. • PLaza 5-7985

ALDEN E. STILSON & ASSOCIATES
LIMITED
CONSULTING ENGINEERS
E. RALPH SIMS, JR.
INDUSTRIAL ENGINEER
MANUFACTURING & DISTRIBUTION STUDIES
245 NORTH HIGH ST. COLUMBUS, OHIO
2060 EAST 9th STREET CLEVELAND 15, OHIO

OUR 11TH YEAR IN AUTOMATION
Serving Industry Nationally
T TECHNICAL
A AUTOMATION
B BUSINESS
ENGINEERS
CONSULTING
ENGINEERING
DESIGNING
BUILDING
INSTALLING
DEBUGGING
CHICAGO, MILWAUKEE & OGDEN AVES. • CHICAGO 22, ILL.

JAMES G. BROWN & ASSOCIATES
Industrial Engineers
Machine Automation • Plant Automation
Process Automation • Complete Plant Design
2505 W. Holcombe Blvd., Houston, Texas
MO 7-8661

EQUIPMENT FOR INDUSTRY, INC.
Overhead Automatic Dispatch Conveyors—
Monorails—Hoists—Cranes
Design, Engineering, Sales & Erection
1265 Atlantic Ave. MAin 2-2400 Brooklyn 16, N.Y.

JOSEPH MONAHAN COMPANY
AUTOMATION SYSTEMS AND COMPONENTS
ENGINEERED APPLICATIONS
•
347-353 Indiana Avenue, N.W.—Phone GL 8-5917
GRAND RAPIDS 4, MICHIGAN

A card in
AUTOMATION
PAYS
DIVIDENDS.

Rates for Professional Service Cards are: $19.00 per month on a yearly basis; $21.00 on a nine month basis; $23.00 on a six month basis; $25.00 on a three month basis (minimum).

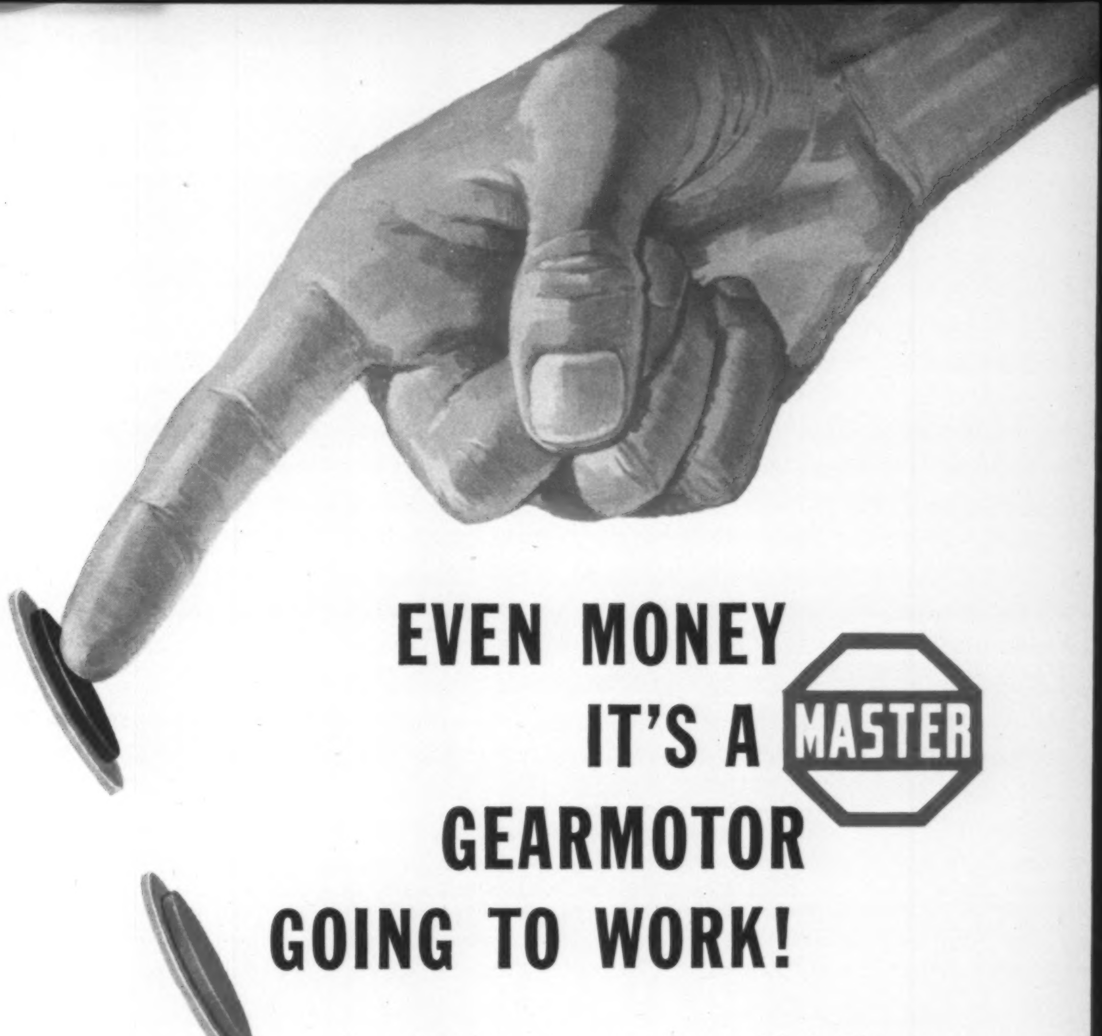
●

POSITION AVAILABLE

Assistant Chief Engineer. Must be experienced in conveyors and special equipment for material handling including package handling, industrial, paint finishing, etc. Please reply giving full details, experience, education, salary desired and photograph for interview. Address Box 112, AUTOMATION, Penton Building, Cleveland 13, Ohio.

POSITION WANTED

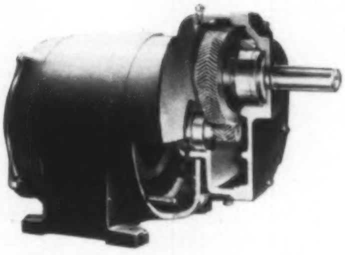
SYSTEMS ANALYST available immediately to assist aggressive staff man working on integrated data processing, experienced office work simplification, flow charts, automatic records control, common language machines, punched card procedures, human relations problems involved in conversion. Address Box 113, AUTOMATION, Penton Building, Cleveland 13, Ohio.



EVEN MONEY IT'S A MASTER GEARMOTOR GOING TO WORK!

We *make* a lot of Gearmotors here at Master. The point is, we've been *selling* more than all other makes combined. There are more Master Gearmotors in *use* than all others. Users *buy* more. And you don't find any foolish motor buyers—or not for long.

So it's obvious that Master Gearmotors simply must meet most requirements best. If you're not a Master Gearmotor user, now's the time to find out what you're missing!



Master Gearmotors are available with all Master motor types in right angle and parallel construction.

IT'S TIME YOUR DRIVE REQUIREMENT MEETS ITS MASTER

With five types of parallel and right angle Gearmotors, Master has the flexibility and choice of design you need.

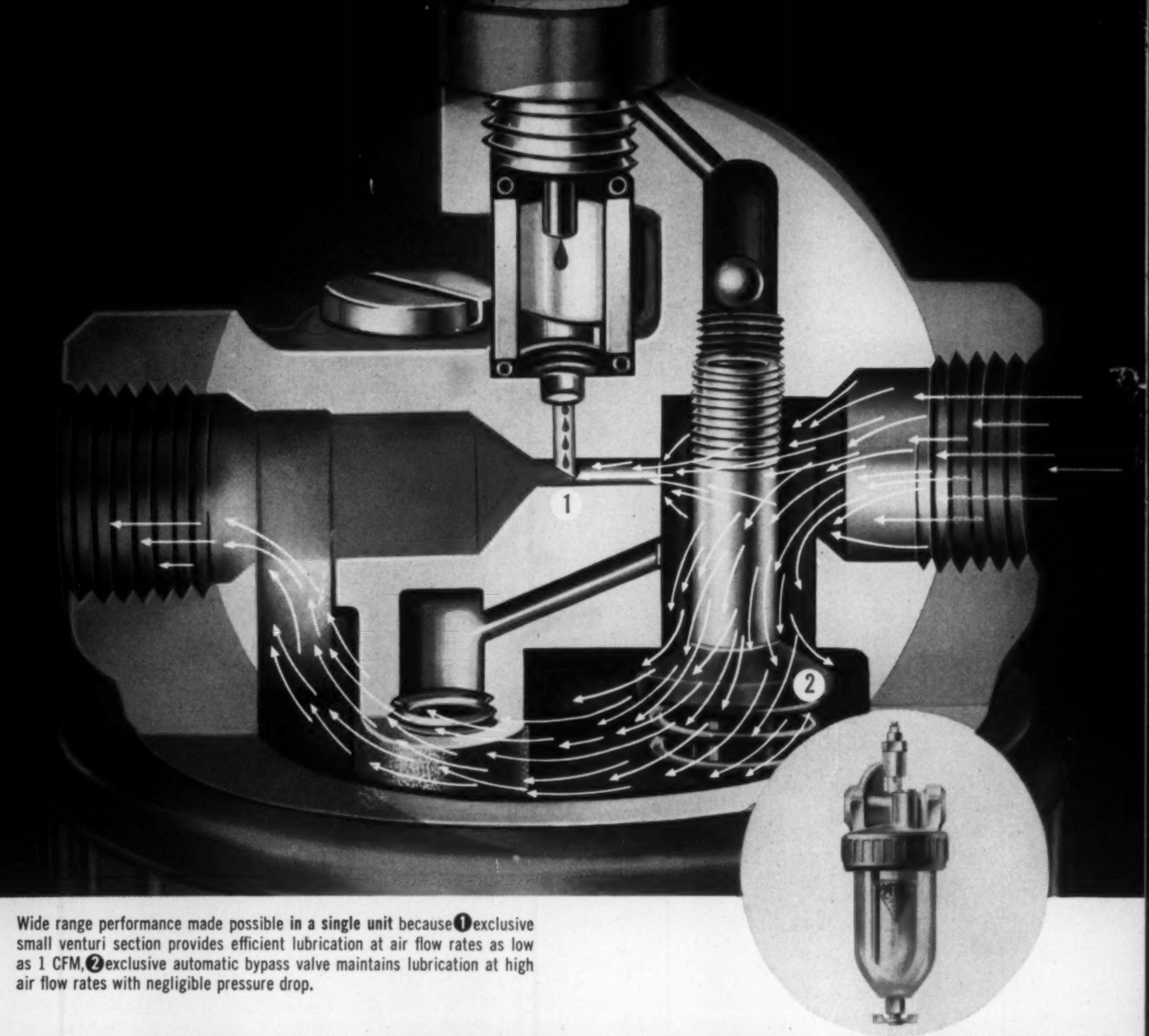
With electric motor and gears combined into a compact, integral power unit, you reduce costs and increase efficiency through elimination of belts, couplings, chains, sprockets, external bearings or separate reducers.

They are available in sizes from 1/8 to 125 H.P. You can integrate with the gearmotor: electric brakes, 3 types of variable speed units and fluid drive in any combination.

THE MASTER ELECTRIC COMPANY • Dayton 1, Ohio

DIVISION OF RELIANCE ELECTRIC AND ENGINEERING CO.

Circle 652 on Page 17

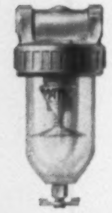


Wide range performance made possible **in a single unit** because ❶ exclusive small venturi section provides efficient lubrication at air flow rates as low as 1 CFM, ❷ exclusive automatic bypass valve maintains lubrication at high air flow rates with negligible pressure drop.

Now! EFFICIENT pneumatic equipment LUBRICATION AT ALL AIR FLOW RATES

Enough oil — but not too much. A fine mist at *any* flow rate . . . ultra-fine, enduring atomization that assures *efficient* lubrication. Tools, chucks, cylinders, other air equipment function smoothly at *any* speed lubricated by Watts air line lubricators.

You get optimum efficiency from these advanced-design units because Watts has *specialized* in protection and control devices since 1875. Exclusive features and precision construction assure reliable, lowest-cost performance.



WATTS FILTERS — exclusive "TORNADO ACTION" provides really clean dry air

Filter life is extended by extreme centrifugal force which spirals dirt and moisture particles downward into "quiet zone", leaving only a minute percentage of the finest and lightest particles to be trapped by the filter cone.

WATTS REGULATORS — sensitive "Aspirator Action" maintains more uniform pressure

Aspirator acts directly on diaphragm giving instant compensation for fluctuating load demands . . . provides precise control and stabilizes pressures reaching individual pieces of equipment.

Write for free technical catalog. Charts, diagrams, performance data enable you to specify the right Watts pneumatic equipment right on the spot!

WATTS FILTERS
REGULATORS
LUBRICATORS — YOUR SAFE SPECIFICATION

Watts Regulator Company — Industrial Division — 10 Embankment Road — Lawrence, Massachusetts

Circle 653 on Page 17